DOCUMENT RESUME

ED 062 189 24 SE 013 678

AUTHOR	Presnell, Richard W.
TITLE	The Development and Evaluation of Audio-Tutorial Programmed Instruction in Learning Concepts of Ecology and Conservation. Final Report.
INSTITUTION	Tomkins-Seneca-Tioga Board of Cooperative Educational Services, Ithaca, N.Y.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C. Bureau of Research.
BUREAU NO	BR-9-B-123
PUB DATE	Sep 71
GRANT	OEG-2-70025(509)
NOTE	326p.
EDRS PRICE	MF-$0.65 HC-$13.16
DESCRIPTORS	*Audiovisual Aids; Conservation Education; Ecology; *Elementary Grades; *Environmental Education; *Evaluation; Instructional Materials; Outdoor Education; Program Design; *Programed Instruction; Research

ABSTRACT

Presented in this final report is a description and evaluation of a one year experimental environmental education program involving 236 fifth and sixth grade students in central New York state. Primary objective of the project was the development, implementation, and evaluation of a series of audio-taped lessons, designed to teach upper elementary school children some basic concepts of ecology and to expose them to the conservation attitudes inherent in the concept of the land ethic. Ten sequential audio-taped lessons, comprising three seasonal programs, were utilized as the mode of instruction. In addition, three seasonal class field trips, each conducted upon the instructed students' completion of the audio-taped program, were included in the overall program. Assessment devices and techniques used in evaluation were student tests, school staff questionnaire, personal observation of students during lessons and field trips, and communication with participating staff members. Programed design and development, implementation, evaluation and findings are related together with instructional materials (hardware, software, lesson scripts, games, charts, and field trips) and samples of the evaluation materials (tests, responses, and questionnaire). (BL)

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FINAL REPORT
Project No. 9B123
Grant No. OEG-2-70025(509)

9-B-123

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THE DEVELOPMENT AND EVALUATION OF AUDIO-TUTORIAL PROGRAMMED INSTRUCTION IN LEARNING CONCEPTS OF ECOLOGY AND CONSERVATION

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September 1971

U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

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The research reported herein was performed pursuant to a grant with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

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CHAPTER I

INTRODUCTION

Writing on the subject of "The Ecological Conscience" in A Sand County Almanac, Aldo Leopold (1949) offered the following words of wisdom:

> Conservation is a state of harmony between man and land. Despite nearly a century of propaganda, conservation still proceeds at a snail's pace; progress still consists largely of letterhead pieties and convention oratory. On the back forty we still slip two steps backward for each forward stride.
>
> The usual answer to this dilemma is 'more conservation education.' No one will debate this, but is it certain that only the volume of education needs stepping up? Is something lacking in the content as well? (page 207)

Leopold's questions remain valid today. Both the volume and the content of conservation education have been stepped up in recent years. Television and radio air a multitude of conservation issues to the public daily. Countless articles in magazines, journals, and newspapers inform us of environmental problems. Numerous books, seminars, public meetings, curriculum guides, and school courses are currently available to alert the citizenry to a threatened environment. School groups gathering litter, concerned youth on hunger marches to alleviate conditions of hunger, malnutrition, and starvation, assemblages gathered to protect endangered marshlands or to protest pollution practices are but a few of the conservation activities that are now commonplace.

The content of conservation education has so expanded that the label "environmental education" has generally replaced the former title. Unlike conservation education, environmental education concerns itself with such issues as the effects of a spiraling human population growth rate. George M. Woodwell (1968) considered population density to be the most fundamental issue in the environmental crisis movement. In the fall, 1970, issue of Environmental Education, Durward L. Allen wrote, "The state of world overpopulation...is so well known and so much discussed as to be almost commonplace".

I expect that Aldo Leopold would be gratified by such education content additions as waste disposal research, pesticide degradation studies, population-energy-use research, recreational land "for the future" surveys, urban crime and urban sprawl studies, and mass transit systems analysis. Now these studies and many more are all considered to be well within the realm of environmental studies and environmental education.

Almost three decades ago, Leopold (in Disch, 1970) asked: "Must we view forever the irony of educating our sons with paper, the offal of which pollutes the rivers which they need quite as badly as books?" Marshall I. Goldman (1967) wrote of the attention the news media today devotes to air and water pollution, and further stated ". . .pollution seems to have become one of America's major issues."

In reply to Leopold's dictum, we can now say that there is 'more conservation education.' It has increased in both volume and content. But the content of environmental education, as before in conservation education, lacks some essential ingredients. Vital to the success of environmental education is what Leopold called the "land ethic". He referred to its need on numerous occasions. In the year 1933 (in Disch, 1970,), he wrote "there is as yet no ethic dealing with man's relation to land and to the animals and plants which grow upon it."

One must read the writings of Aldo Leopold to fully understand and appreciate his concept of the land ethic. The need for his land ethic in today's version of conservation education is but one of my arguments for the research reported herein, and in the hope that the reader will go directly to the source for a complete picture of the land ethic I will but summarize it here.

The function of Leopold's land ethic was to prompt man to do more than follow his instincts and compete within his community. The land ethic would prompt each man to co-operate with the community. The very definition of a land ethic hinged on Leopold's concept of man's "community". To Leopold, man's community included the earth's soils, waters, plants, and animals. I'm certain that today he would add the earth's atmosphere to the boundaries of man's community, and I expect he would have no objection to the further addition of extra-terrestrial space as well. The land ethic message can be found in the following quotation:

> In short, a land ethic changes the role of Homo sapiens from conqueror of the land-community to plain member and citizen of it. It implies respect for his fellow-members, and also respect for the community as such. (Leopold, 1949)

The scarcity of the land ethic in today's environmental education was instrumental in my decision to undertake this study. The philosophy of Leopold's land ethic served as a guide in the writing of the content of the instructional program of this study.

The general absence of another ingredient in today's environmental education efforts was also instrumental in the design of this study. This essential and commonly missing ingredient is what I call an "ecological awareness."

A variety of awareness exists in most environmental education messages. The word "awareness" is in fact omnipresent. "Making the public aware" is professed to be the primary objective of most environmental campaigns, programs, and conferences. The awareness so commonly voiced is usually, however, the shallow awareness of the existence of one or more environmental problems. This kind of awareness is per se grossly inadequate to the solution of existing problems and to the prevention of future problems. The additional "awareness information" commonly found is that a given problem is the result of some specific action, policy, or material. This kind of awareness is likewise insufficient to effect a durable solution to or prevention of the degradation of the environment.

Cognizance of environmental problems and of their causes is of course essential. But too often the education message ends with such information or with an appeal to the public to stop some "bad" action or policy. Another kind of awareness is needed. Necessary to the message of environmental education is a host of rather specific and often detailed information about the causes and consequences of environmental problems. Ecological knowledge is imperative to the solution of such problems. Also imperative is critical thinking based on ecological information. Needed are ecological understandings of possible alternative actions to alleviate environmental problems, and knowledge of the consequences of each alternative action. The prevention of new problems likewise will require critical thinking of an ecological nature. What is required in an effective environmental education program is a message that will create both a conservation "conscience" and an ecologically "aware" public.

Shallow and emotional appeals will soon be rejected by an increasingly "problem-aware" citizenry. Oversimplified messages concerning the causes and cures of environmental problems will be no more effective toward the solution of the problems than were such messages of conservation education in the times when Aldo Leopold wrote:

> Conservation is paved with good intentions which prove to be futile, or even dangerous, because they are devoid of critical understanding either of the land, or of economic land-use. I think it is a truism that as the ethical frontier advances from the individual to the community, its intellectual content increases. (Leopold, 1949)

A critical understanding of the land and of economic land-use is the ecological awareness too often lacking in environmental educations messages today. Such understandings are not easily obtained. Few of today's legislative decision-makers, industrial leaders, or adult voting citizens have had much opportunity to develop such understandings. Notions of ecology were seldom a part of their schooling. Granted that much of today's ecological wisdom was in the formative stages but a few years ago. Now, ecological research has provided us with many new insights into the workings of the land. We can no longer excuse the absence of ecological teachings from our schools with either the explanation that we know too little to justify time spent with ecological teachings, nor with the argument that such studies are irrelevant to today's educational goals.

Today's youth -- tomorrow's decision-makers -- will arrive at conclusions about environmental problems and solutions to such problems with or without the assistance of our schools. If their conclusions ar oversimplified and invalid, and if their solutions are ineffective or precipitate even more serious problems, we who consider ourselves to be environmental educators must take a large portion of the responsibility for their errors. To develop critical thinking in today's youth educational programs which provide both the development of a conservation conscience and an ecological awareness are imperative. One can "think critically" only about matters that one understands. This study is an attempt to create, implement, and evaluate one type of educationa program to help meet this end with one portion of our public. Many programs of varied and innovative designs will be necessary to reach and educate all portions of our public.

CHAPTER II

THE RESEARCH PROBLEM

The need for environmental education in schools

In Our Environment Can Be Saved, Governor Nelson A. Rockefeller (Rockefeller, 1970, page 155) admonished individual citizens to "educate yourselves about ecological principles, the interdependence of all living things with their environment." Governor Rockefeller is not alone in his plea. Today, thousands of voices echo the need for the public to arm itself with ecological knowledge in order to prepare to save a rapidly deteriorating environment.

John E. Klimas, while a program director for the National Science Foundation, addressed similar pleas to our schools' teachers in general and to our elementary teachers in particular. In answer to a query about the role of elementary school teachers in environmental education, he replied, "Teachers are going to have to start giving their students an environmental framework within which to study science. It (instruction) has to have some relevance to man's total environment. Without some notion of the interrelationship and interdependence of things in nature, tomorrow's adults simply won't have the intellectual tools necessary to make choices about the uses of technology." (Klimas, 1969, page 94)

I agree with Klimas' admonition, but believe the task of including such instruction within the existing curricula of elementary schools is a formidable one. The task is of such magnitude that little has been accomplished to date. Many environmental educators have commented on both the need for more environmental education within our schools and the small number and poor quality of existing programs. Martin W. Schein, writing about the nation's elementary and secondary schools' failure to teach children conservation, attributed this failure to the paucity of teachers capable of teaching conservation and ecology. He wrote that elementary teachers need, but aren't getting, instruction in ecology, resource management, and field work which could give them understandings necessary to the teaching of environmental education in their classrooms. (Schein, 1969, pages 18 and 19)

Is the need being met?

The primary objective of a recent survey conducted by the Research Division of the National Education Association was to ascertain how the need for environmental education was being met in the nation's schools. In a series of inquiries into the type and extent of such education available to our youth, 7,143 school systems that collectivel enroll ninety per cent of all public school students in the country were contacted. An initial inquiry asked the superintendents of the school systems whether their systems were conducting environmental education programs in which a staff person was involved for the equivalent of at least one-half time. Seventy-two per cent of the initially contacted superintendents responded. It was found that only 781 school systems, slightly over 13 per cent of the respondents and a number representing about 11 per cent of the vast majority of the natio public schools, indicated they had a program at some grade level or levels that met the qualifications. Indeed, a very small per cent of the nation's schools have substantial offerings in environmental education today.

A second questionnaire comprising the actual survey instrument was then sent to the 781 schools to determine such program information as: program objectives and content, grade level coverage, length of program operation, type of administration, instructional procedures, methods and procedures of curriculum design, background of program designers, types of outdoor facilities utilized, degree of use of national park facilities and/or resources, methods of evaluation, amounts of capital outlay and operating costs, sources of funding, and types of assistance believed required to develop their programs further.

Although most environmental educators agree that all public schools should have environmental education offerings of some type at all grade levels and within the structure of each school subject, the National Education Association survey indicated that not only do only a small minority of schools provide instruction, but also the majority of programs offered were characterized by their school systems as "outdoor education" rather than "environmental education".

Evaluation in existing programs

Of particular interest to me were the responses of schools to questions about program evaluation. Most schools, from 31.2 per cent to 80.6 per cent, with the number dependent upon the grade level usage of the programs, indicated that a major method of program evaluation amounted simply to giving students grades for their work or granting students academic credit for having attended the program. The only information reported that indicates any attempt to evaluate the usefulness of the programs was data showing an "attempt" was made to determine pupil attitude change. A majority of responding schools claimed that they were concerned with the attitude of their students toward their environment, and that they had attempted to measure changes in students' attitudes. Not reported, however, were either successes in measuring or successes in having changed pupils' attitudes toward the environment.

The survey failed to ask the important questions. It failed to ask questions concerning the evaluation of the environmental education programs themselves. Not asked were such questions as, "What instruments or techniques did you employ to ascertain what or whether the pupils learned?", or "What sorts of changes in skills, attitudes, concept attainment, information acquisition, and the like, did your evaluative data show?". The failure of the survey to investigate these kinds of questions is a failure common to most educational survey studies and curriculum development projects. Few educators seem willing to ask whether or not their instructional materials do indeed make any significant changes in pupils.

A recent Time magazine article reported that P. Kenneth Komoski, leader of a non-profit educational products information exchange group, testified recently before a House subcommittee that ninety-nine per cent of the nation's teaching materials have never been systematically tried out to see how much students actually learn from them.[1]

The fact of education's failure to adequately assess instructional materials may, when fully realized by the public, spell the death knell for needed additions to our school's curricula -- including scarce and sorely needed environmental educational instruction. The cries for accountability in educational practices and materials are rapidly growing louder.

---

[1] "Untested Textbooks" in Time, Time Inc., New York June 7, 1971, page 33.

Instructional expenditures for environmental education

It was with more than "passing" interest that I noted the operational and development costs of the environmental education programs reported in the National Educational Association special report (op. cit., pages 67 to 70). The mean capital outlay budgets for programs ranged from $14,071 for small school systems to $206,360 for large school systems, with one system reporting an expenditure of 1.5 millio dollars for capital outlay. Mean current (1969-70) operating costs for programs ranged from $29,158 for medium sized systems, to almost $103,000 for large systems, with small school systems having a mean operating expense of $47,078. Although some schools spent as little as one hundred dollars for the year's operating expenses, one school system reported having spent 2.5 million dollars.

Apparently, some of the nation's school systems can afford extensive and expensive environmental education programs. Many of our schools, possibly a majority of them, are currently in financial straits that not only prohibit the addition of new programs but commonly have resulted in curtailing existing portions of their curric I expect that consideration of both costs and learning outcomes will b required before many environmental education programs will be added to the curricula of our schools. The cries of inspired citizens for "ecologically and conservationally aware" children will too easily be drowned out by the voices of over-burdened and disillusioned taxpayers.

If, then, an environmental education program is to be successfully added to existing school programs, it must at least meet the requirements of low initial purchase cost and operating expense, and of learning outcomes accountability. With these and with other considerations in mind, I will now discuss the purposes of this project and then indicate the objectives of this research.

Purposes of this study

The primary purpose of this study is the development, implementation, and evaluation of a low cost, one-year experimental environmental education program for fifth and sixth grade students -- a program designed to assist these students in developing ideas of conservation and ecology useful in observing, interpreting, and understanding events in their environment, and a program which stresse the philosophy of the land ethic and the understandings of the ecological awareness described in chapter one.

Several considerations resulted in my choice of fifth and sixth grades for this project. My teaching experience at the junior high school and upper elementary grade levels was one consideration. A belief shared by many, both within and out of education is that the development of attitudes and the acquisition of basic skills and of elementary understandings, can occur most easily, with appropriate instruction and experiences, in the pre-school and early school years. Another consideration for this choice of grade levels was my feeling that fifth and sixth grade students would be likely to possess the subsuming concepts necessary to the acquisition of the kinds of ecological concepts and conservation understandings I hoped to teach.

Another purpose of this study was to design an instructional program so structured that it would result in students being taken on outdoor field trips in areas around their schools, and thereby be given opportunities to apply any acquired observational skills and interpretative understandings to their environment. Also, knowing that some school's policy and/or other constraints prohibit class outdoor field trips, I also wanted to design portions of the instructional input in such a manner that students might be capable of initiating and conducting their own field investigations with their friends and families. The above purpose of designing field investigations into the program is based on the commonly held belief that outdoor experiences can, when preceeded by proper pre-field instruction, provide students with concrete examples of conservation and ecological phenomena.

Other purposes of this study involve the designing of an instructional program that can be efficiently administered in elementary schools. In my experience, I have found elementary school teachers generally to be a dedicated and hardy lot. However, I have also found them to be over-taxed in responsibilities and time. Therefore, a purpose of this study was to design instructional materials that would not add to their burdens by requiring substantial expenditures of time, energy, or money (for supplementary instructional materials and gadgetry).

The instructional mode

To meet the above purpose, and because of other considerations given below, an audio-taped mode of instruction, consisting of complete packages of instructional lessons, was chosen for the instructional mode of the environmental education program. My experience with an earlier, short-term project involving my designing, developing and implementing a series of audio-taped lessons, convinced me that this mode of instructional input was an excellent choice for use in this study. One of the merits of audio-taped lessons is their ease of use. Individual students, at times when they are not involved in group instruction or other activities, attend the lessons individually. With a minimum of planning, the lessons can be so scheduled that all students can attend the lessons in a relatively short period of time.

Even more important reasons for the choice of an audio-taped (sometimes called audio-tutorial) mode of instruction have been elucidated by James J. Gallagher (1970), K. Michael Hibbard (1971), and John A. G. McClelland (1970). Gallagher's study of the use of the audio-tutorial instructional mode versus both a teacher taught and a combination audio-tutorial and teacher taught mode, offers a realistic reason for the use of the audio-tutorial mode of instruction. Gallagher's data provide evidence to support the idea, suspected by most who have observed the use of well designed audio-taped lessons, that pupils instructed via this mode are distracted from the lesson input for a much smaller proportion of instructional time than are pupils instructed in teacher-directed, group instructional modes. Elementary teachers, and others who are involved in instruction with elementary school aged children, generally agree that lack of attention to instructional input is a common and a major cause of lack of success in learning. The attention-holding quality of the audio-taped individually attended instructional mode, therefore, seemed well suited for this study.

An even more important consideration than the rarity of distractions was that resulting from the studies of Hibbard and McClelland. Hibbard's study of first grade students' learning of the relatively complex concept of the particulate structure of matter involved the use of the audio-taped, individually attended, mode of instruction. McClelland's study of second graders' acquisition of energy concepts also indicated that the audio-taped mode could serve as an effective instructional technique for the teaching of rather sophisticated and detailed science concepts to elementary school children.

The use of the mode in teacher education

Considering the general inability of elementary teachers to offer environmental education instruction emphasizing ecological and conservation concepts, and considering the rapid teacher turnover rate in elementary schools (usually requiring retraining of new teachers for the continuance of specific programs), the audio-taped mode of instruction was again felt to be the best choice for presentation of instructional input. With the audio-taped mode, continuing administration of the program with either experienced teachers or new teachers would be possible without extensive training of school personnel. The author is well aware of the important role a trained and dedicated teacher can play in providing excellent instructional activities to supplement even the most highly structured and self-contained programs comparable to that under consideration in this study. Most untrained elementary teachers would be capable of designing a wide variety of conservation and ecology learning activities if they were given the opportunity to acquire adequate training in these disciplines. Teacher training in these disciplines is available to some teachers at a few teaching training institutions and at a few governmental and private workshops. Hopefully, such training will become more readily available and accessible to more teachers and would-be teachers. The vast majority of today's elementary teachers and teachers-in-training do not have easy access to such instruction. Regardless of their dedication to education in general, or their empathy toward the goals of environmental education in particular, the fact of the matter is that most existing classroom teachers lack the time, energy, and many, the desire to devote their "off-school" hours and/or summer vacations to additional teacher training sessions.

If environmental education is as necessary to our society and as urgently needed as most educators agree it is, innovative ways must be found to rapidly and effectively provide such instruction to both students and teachers. A reason for employing the audio-taped mode of instruction in this study was to offer meaningful instruction to not only the elementary school students, but to their teachers as well. It was felt that the maturity and experience of interested teachers would provide them with the necessary background information to effectively subsume ecological and conservation notions via the audio-taped mode with a minimum amount of time and effort. The amount of time required would be equivalent to less than two school weeks of one-half lunch-hour time during the entire school year.

Summary of Objectives

The objectives of this study may now be summarized:

1. To develop, implement, and evaluate a series of audio-taped lessons, designed to teach upper elementary school children some basic concepts of ecology and to expose them to the conservation attitudes inherent in the concept of the land ethic.

2. To design the content of the lessons in such a manner that the lessons could effectively prepare upper elementary students for three seasonal outdoor field trip experiences in areas adjacent to their schools and/or home, or within relatively easy access to these places.

3. To develop a series of lessons that could serve as a model for the construction of similar instructional materials for use in other geographical areas, with other grade levels, and for use by other environmental education agencies.

4. To design and implement the lessons in a manner that their inclusion into an upper elementary school curriculum would not appreciably disrupt other classroom activities and schedules, nor burden classroom teachers with additional instructional duties and responsibilities.

5. To develop instructional materials that could be easily reused by schools and/or loaned to other schools for their use, and at the same time, require a minimum of repair and replacement expense to the schools.

6. To develop the lessons in such a manner that they could serve as in-service training instruction, in order that those classroom teachers who were so inclined to attend the lessons, could in a short time review previously learned conservation and ecological information and/or learn ideas of conservation and ecology new to them.

7. To evaluate selected student learning outcomes of the audio-taped lessons and evaluate selected student behaviors displayed on the post-lesson outdoor field trips.

8. To evaluate the effects of the field trip experiences on learning of selected conceptual and factual information contained within the audio-taped lesson series.

9. To gather and assess opinions and recommendations of school staff members directly involved with the administration of the environmental education programs herein reported.

Assumptions

Many assumptions influence the decisions made in a study of the type herein reported. Some of the more pertinent assumptions are listed below:

1. That ecological and conservation understandings enhance a person's ability to observe and interpret natural objects and phenomena in the outdoors.

2. That outdoor experiences with concrete examples of natural objects and phenomena will reinforce a person's understanding of ecological and conservation concepts.

3. That most elementary students' curiosity about natural objects and phenomena will assist in motivating such students in learning ecological and conservation information both within the classroom and in the field.

4. That, given the opportunity for easily accessible instruction in some of the notions of ecology and conservation, many elementary school teachers will attend such instruction.

5. That those elementary teachers who possess extensive training in conservation, natural history, and ecology, will feel a need to offer environmental education experiences to their pupils both within their classrooms and in the field.

Scope of the investigation

The scope of this study was largely determined by the requirements of the U.S. Office of Education Small Grant Research Project Number 9B123, under which the author conducted this research. The dictates of such grants require that both local funding and local school participation be integral aspects of investigations conducted under their sponsorship. The fifth and sixth grade classes participating in this study as the instructed (experimental) classes, were selected as a result of the agreement of the principals of Danby Elementary School and Enfield Elementary School, both of the Ithaca, New York School District, for their schools to serve as the local contributing and particpating schools. With the exception of students who left or joined the fifth and sixth grade classes at Danby and Enfield Schools during the academic year, the members of the instructed classes remained the same throughout the study.

The non-instructed (control) fifth and sixth grade classes were provided by Northeast Elementary School, another school of the Ithaca School District. The choice of these classes was arbitrary and resulted from the author's acquaintance with the principal and assistant principal of Northeast Elementary School. The participating members o the non-instructed classes were involved in a portion of the evaluatio procedures of the study, and they varied depending on which Northeast School classroom teacher felt she could work the tests into her classroom schedule at the times the tests were to be administered, and which students were present in such classes at those times. Although the author felt that this arrangement was less than optimal, he was grateful, under the circumstances, for the assistance of the Northeast classes.

The study was designed as a one year project, scheduled for termination on May 31, 1971. Lesson design and development was begun in June 1970. Ten sequential audio-taped lessons, comprising three seasonal instructional programs, were planned. The first four lessons were designed for use during the autumn months, the next three for use during the winter, and the remaining three were designed for use durin the spring months. Three seasonal class field trips, each to be conducted upon the instructed students' completion of the audio-taped programs, were included in the over-all program. The intent of the field trips was for both motivation and instruction. The instructiona aspects of the field trips were intended to be incidental.

Evaluation procedures

Evaluation procedures were planned to serve a number of objective For purposes of final revision of audio input, observation of students attending each of the ten audio-taped lessons were planned. The autho used brief check lists pertaining mostly to students' mechanical performance, and conducted brief post-lesson student interviews to determ if each lesson required additional revision. These observational eval uations were planned and performed with upper elementary school aged children from the author's neighborhood, and from the instructed class Interviews with instructed students were very brief and did not, in th opinion of the author, appreciably influence subsequent responses of the interviewed students on lesson and field trip assessment devices. The major assessment devices planned were five production tests of the short answer and hand-drawn picture type, for use in assessing student knowledge to be considered in final lesson script writing, and for determining changes in student responses after they had experienced the audio-taped lessons and/or the field trips. All tests were planned to require a minimum of classroom time. The time requirements of the tests were highly influenced by the author's desire to interfere with normal classroom activities and schedules as little as possible, and by his additional desire for the evaluative devices to play a minimal role in instructing the students.

The personnel involved in the study included the author, who designed, developed, implemented the program, and evaluated the students' responses to the evaluation devices, the author's doctoral program chairman who edited lesson scripts, the teachers who administered the five production tests and the student-use of the audio-taped lessons, and one principal and some teachers and practice-teachers who accompanied the students and the author on some of the field trips.

CHAPTER III

PROGRAM DESIGN AND DEVELOPMENT

Early design and development

Program design and development for this study was begun, in a sense, in the winter of 1968-69, when the author designed, developed, implemented, and administered a pilot series of three audio-taped lessons in selected biological concepts and a single field trip, for a fourth grade class at Belle Sherman Elementary School in Ithaca, New York. The author's evaluation of this pilot study lead him to conclude that a longer-term program for the purposes outlined in the previous chapter might be feasible. One conclusion drawn from this earlier study was that, although the fourth grade students appeared to have gained some biological information, and they seemed reasonably able to manipulate the lesson materials, one or two years of maturity and experience would be necessary in order for elementary school children to successfully learn the information the author anticipated teaching in this instructional program.

The instructional hardware (tape recorder, earphones, hand-held slide viewer-magnifier, and slide box) employed in the pilot study, were found to be quite satisfactory for student use, and were again used in this project. The duration of the pilot study was too short and the coverage, consisting of but one class, was too limited to reach any conclusions about the possible success or failure of the audio-taped mode of instruction as a teaching tool in other upper elementary school classrooms. It should be noted that although successful use of the audio-taped mode in teaching selected science concepts to lower elementary school children has been accomplished by a number of investigators prior to this study, the routine classroom procedures and activities of upper elementary school classes are usually far different from those of lower elementary school classes, and essentially nothing was known as to the applicability of the audio-taped mode of instruction in the upper grades.

Design and development procedures for this study

Designing of the audio-taped lessons of the study discussed here consisted of the author: (1) choosing what information to include in the audio input of the lessons, from ecological, conservation, and natural history literature available to him, (2) assessing the kinds of information upper elementary school children have about the chosen audio input information, (3) revising the lesson scripts (audio input) on the basis of what was learned from the assessment of childrens' knowledge, and further sequencing the lesson script information so as to present it in a sequence that reflected both the logic of the ecological and conservation concepts and the logic of the learner, (4) choosing and assembling various kinds of visual illustrative materials to exemplify the various ideas of the audio input information, (5) trying out the audio and visual materials on selected upper elementary school children, and (6) performing the final revisions of the audio and visual lesson materials, with the nature of the revisions based on feedback from the children involved in the final tryouts.

The development activities for this type of project cannot be completely distinguished from the designing activities. The two endeavors occur more or less simultaneously and greatly influence each other. Development activities involve primarily the production, acquistion, and duplication of both the audio input and the visual and manipulative illustrative materials. The primary lesson development tasks completed by the author were: (1) recording and duplicating the revised and final versions of the audio scripts, (2) photographing hundreds of subjects using a 35 mm single-lens reflex camera, (3) duplicating the color slides taken by means of a slide duplication apparatus attached to his camera, (4) enlarging and printing the black and white photographs used in the lessons, (5) acquiring additional color slides from personal friends and commercial sources, (6) having selected color slides reproduced as enlarged color photographs, (7) drafting, drawing, and duplicating the charts, signs, diagrams, and cartoons used as bulletin board illustratives materials, (8) acquiring bulletin boards of a size that would fit the space requirements of standard learning-center lesson carrells and be of such weight and size to easily rest upright on the back of a standard student desk in a classroom, (9) arranging and affixing selected bulletin board software materials (enlarged photographs, charts, and the like), (10) ordering and pencil-labeling each copy of each of the color slides with letters and numbers to indicate its slide number, lesson number, and seasonal program, and (11) inserting all color slides in purchased plastic slide protection sleeves and making and affixing color label-maker numbers corresponding to slide numbers on the upper-right hand corner of each slide protection sleeve.

The design and development of the software materials for this study began in June 1970, and continued throughout the production phases until the final revision of lesson ten, the third spring lesson, in early May 1971. In the early designing stages, and to a lesser degree, throughout the period from June 1970 to early May 1971, the author consulted and reviewed a wide variety of books, periodicals, leaflets, and other writings he felt were relevant to the design and development of the instructional materials. Most of the literature so employed is listed in the uncited references of this thesis.

In outlining the content of the lessons, much consideration was given to the kinds of information other environmental educators had included in a variety of conservation and environmental education curriculum guides. Of greatest value, however, were the writings of Professors Verne N. Rockcastle, Richard B. Fischer, and Eva L. Gordon (now deceased), and others, found in the New York State College of Agriculture publication, the Cornell Science Leaflets. The single most commonly used guideline for the writing of ecological concepts instruction, was Robert L. Smith's basic textbook, Ecology and Field Biology (1966). Numerous references from Smith's book were reviewed when it was felt that original or more detailed references were required.

In addition to consulting the ecological, conservation, and natural history references, much consideration was given to the writings of some learning theorists and practitioners in curriculum design and development. Advice was also sought, and received, from the author's doctoral committee chairman, Professor Richard B. Fischer, and from various members of the staff of the Elementary Science Project, an on-going elementary school audio-tutorial science curriculum development project in the Division of Science and Environmental Education at Cornell University.

The major concepts of the instructional program

Upon consideration of the ecological, conservation, natural history, learning theory, and curriculum design literature, the author outlined the various ideas he thought were important to the goals of the program and were attainable by upper elementary school children. Following are the major ideas the author decided were appropriate for use in the instructional program:

1. The idea of energy flow in the biosphere, from the sun via photosynthesis in photosynthetic plants and via food webs throughout the biotic parts of the environment.

2. The notion that ingested food is the energy source for consumers.

3. The idea that the sun is the energy source for photosynthetic plant

4. The idea that dead organic materials provide the energy source for decomposers.

5. The idea that inorganic materials, provided in the earth's waters, soils, and in some instances, air, are necessary to living things for anabolism and growth.

6. The idea that all forms of life are similar in that they require much the same basic things to stay alive and healthy.

7. The notion that the earth, and most probably only the earth, provides the various natural materials and living conditions required by the organisms that inhabit the earth.

8. The idea that man is much like all other living things in that man too requires the living conditions and materials the earth provides.

9. The idea that, without the disruptive effects of pollution practices of man, the earth would most likely continue to provide a diversity of materials and conditions required by living organisms.

10. The idea that man's use of the earth's materials and alteration of the earth's living conditions need not interfere with the continuance of life on earth, if people make 'environmentally' correct decisions about their use of the earth's materials and conditions.

11. The notion that knowledge of the earth and of the organisms (including man) that inhabit the earth, must be the basis for man's ability to make 'environmentally' correct decisions as to his use of the environment in the future.

12. The idea that reproduction by living things is the method of continuation of species on the earth.

13. The notion that organisms grow through various stages before they are capable of reproduction.

14. The idea that both abiotic and biotic aspects of the environment exert constraints upon the reproductive success of each species.

15. The notion that all plant and animal species vary in such things as structure, behavior, and habitat preference.

16. The idea that such variation has evolved throughout a long period of time.

17. The notion that such variation makes possible the efficient use of the earth's resources by living things.

18. The idea that the timing of various plants' and animals' activities and behaviors are not only "natural events", but are necessary to the continuing survival of each species.

19. The idea that the primary environmental clue to the correct timing of seasonal activities and behaviors of living things is change in daylength during the year.

20. The idea that members of the same species interact with each other in ways that generally benefit the species rather than the individual.

21. The notion that members of different species interact with each other in ways that generally benefit the interacting species rather than individual members of the interacting species.

22. The idea that all living things not only interact with other living things, but also interact with their surrounding environment, and in doing so, change the environment in some way.

23. The idea that variation in seasonal temperatures on earth results primarily from the fixed inclination of the earth's axis as it influences daylength and the inclination of the sun's impinging rays.

24. The idea that they, the students, can with a minimum of equipment and effort, go outdoors and observe the earth's materials (abiotic and biotic) and phenomena, and learn much about their environment.

25. The idea that they, the students, can paly an important role in making the environment a healthy and enjoyable place for people and a healthy place for all other of the earth's inhabitants to live.

Efforts were made in the program design and development to include all of the above ideas and many of their more specific sub-ideas. Interested readers will find the audio-scripts of each of the ten lessons in the appendix, and will find upon perusal of the scripts, the manner in which the various ideas and sub-ideas were presented to the students.

Development of instructional materials

An outlining of preliminary scripts for each audio-taped lesson was followed by a listing of examples of plants, animals, other objects, and/or phenomena that I believed would, in the thinking of fifth and sixth grade children, adequately illustrate the ideas I hoped to teach. Because the majority of illustrative materials were planned to be in the form of two by two inch color slides, much consideration of actual illustrative subjects was based on the likelihood of my being able to photograph the subject or procure photographs of subjects. Professor

Richard B. Fischer offered the use of his extensive and excellent personal collection of color slides and I often took advantage of this opportunity to use his slides. Most of the slides used were taken by the author primarily because specific subjects or phenomena were felt to be required to illustrate specific ideas in the audio scripts.

Additional illustrative software materials were chosen by the author and were developed and replicated, as were the slides, in three copies. (For efficient use of the lessons within the schools, two copies of each lesson were required by the Enfield classes and one copy by the Danby classes.) Each audio-taped lesson was designed to be accompanied by a bulletin board containing both simple lesson use directions, and illustrative materials. The charts, diagrams, cartoons, enlarged photographs, and instructional signs employed, were produced and replicated by the author. For selected lessons, additional illustrative and manipulative materials were selected. A number of lessons included the use of one or more paperback books from the Golden Nature Guide series, published by the Golden Press in New York. Some lessons contain natural materials, such as woody twigs and bags of winter deer browse. Other lessons contain illustrative and manipulative models. These materials were collected and/or produced by the author in sufficient quantity to supply three copies to the specific lessons.

As a group activity to supplement the winter lessons, the author designed and produced a wildlife ecology game he titled, "How Was Your Winter?". A study of childrens' games in the author's home and in the homes of neighbors, aided in the design of the wildlife game. Also, instrumental in the design and development of the game were the opinions of a large number of children and adults who aided in the testing and revisions of the game prior to its use in the learning-centers of Danby and Enfield schools.

With the exception of the final version of the autumn program scripts and final selection of autumn program color slides, most of the software for the autumn lessons and much of the software for the winter and spring lessons were designed and developed during the summer of 1970. On September 25, 1970, shortly after the end of the summer recess for the Ithaca schools, the pre-program test, test one, was administered to the Danby and Enfield fifth and sixth grade students by their classroom teachers. An accurate facsimile of the test administration directions, test questions, and students' test response booklets for test one and for all subsequent tests, can be found in the Appendix.

I draw the reader's attention to the incomplete nature of the autumn lesson materials at the time the pre-program test was administered to the instructed students in order to provide a background for the following discussion of the function of test questions in the design and development of specific audio script content.

Two types of test questions were used in the evaluation program of this study. One type of questions, exemplified by question one of test three, occurred but once in the testing of students' knowledge. The function of this type of test question was to provide the author with information about the students' knowledge and/or experience at a time when this information could be used to revise lessons scripts and other lesson software so as to improve the instruction. Most of the test questions used were of a second type; they were repeated one or more times throughout the five evaluative tests. All the repeated test questions, like the non-recurring questions, were intended in part for use as pre-instruction questions. Students' responses to the first use of repeated questions were also used in the final and/or close to final revisions of lessons.

The rationale for using students' responses to pre-instruction test questions as a tool to improve instruction, comes from many sources. I think Hibbard (1971, page 149) said it best, when in his concluding remarks he wrote, ". . . specific knowledge and experience of children should be of the utmost influence in selecting and structuring information as a process of curriculum design." The philosophy of attempting to fit the content of the instruction to the previous knowledge and experience of the learners, was the primary reason for the author's choice of the specific test questions used in the evaluation of this study. The decision to repeat the majority of test questions in later testing was based on the author's desire to assess the kinds of changes in the students' knowledge, which would hopefully be reflected in their subsequent responses to the questions.

Field trips in the instructional program

Three post-seasonal audio-taped lesson program field trips were designed by the author and planned with the aid of the principals and some of the teachers of Enfield and Danby schools. All trips were planned for areas adjacent or close to the schools and were designed to use as large a variety of the relatively natural habitats these areas could provide. Both Danby and Enfield are rural schools and the areas in the neighborhoods of the schools provided weedy fields, hardwood woodlots, a small amount of mixed hardwood-conifer woods, shrub-dominated areas, a variety of marginal areas and fence-rows, small permanent streams, and in the case of Enfield, a small farm pond. A small park and reservoir was within a few minutes driving distance of the Danby school, and the impounded water and a small stream were used at this site for the spring season field trips for Danby students. The author's station wagon provided transportation of students and equipment for these class field trips. All other field trips at both schools were "walking" field trips.

The primary purpose of the outdoor field trips was to insure opportunities for the instructed students to go outdoors to observe and interpret natural objects and phenomena in their immediate environment. This may seem to be a trivial purpose considering the fact that the vast majority of instructed students live and attend school in a rural setting. But any assumption that rural children of today frequently, or for that matter, infrequently, visit the outdoors simply because they live in a rural area, is a very poor assumption. Most of the students in the fifth and sixth grade classes at Enfield School had seldom visited the kinds of environments attended on the autumn and winter field trips, and even fewer had previously examined the pond and stream environments visited during their spring field trips. Such was not the case at Danby School, where the fifth and sixth grade students were frequently taken on "discovery" types of field trips by their science teacher. Had the Danby science teacher not been both well trained in outdoor education and inclined to take his students on outdoor field trips, I would imagine that these students too, would be quite inexperienced in outdoor environments.

A second and almost equally important purpose of the field trips was the desire to motivate the students. The prospect of being taken on outdoor field trips was met with enthusiasm by almost all instructed students at both schools. A third purpose of the field trips was to provide the author with information about the success or lack of success of the audio-taped instructional programs. To meet this end, games were devised by the author to provide both direction and structure to the autumn and winter trips, and provide information with which some assessment of the lessons could be accomplished.

The autumn field trip game consisted of dividing each field trip group into two sub-groups and asking them to find evidence outdoors of the following nature: (1) one sub-group was asked to find and/or gather "evidence of living things having prepared for winter living conditions." (2) the other sub-group, comprising the other half of the group, was asked to gather "evidence of living things having prepared for spring and the next "growing season." The students worked as groups to find, gather, or point out and further explain why various examples of natural objects or phenomena constituted the kinds of evidence they were asked to find.

Employed on the winter field trips was a winter resident wildlife survey game which required a search for evidence of winter wildlife and/or their sign by a number of sub-groups of each field trip group. Details of the winter field trip survey game are reproduced for interested readers in the Appendix. The results of the students efforts to identify and gather evidence of the use of the land around their schools by winter resident wildlife is also tabulated in the Appendix.

The spring field trips can best be characterized as "discovery" field experiences which emphasized student sampling of pond and stream life. The author furnished metal soup strainers, cut-off one-half gallon size milk cartons for specimen holding and examination, larger aluminum specimen examination trays, and a number of one gallon plastic and glass containers in which the students carried selected stream and pond life back to their science classrooms for further study.

Supplementary instructional materials

A wide variety of instructional materials for teacher and/or student use as supplementary materials for the audio-taped lessons and field trips were provided to the instructed students' science teachers by the author. The materials were provided for possible use by any or all of the teachers of the instructed students.

Packages of sixty reprinted conservation and natural history articles were obtained gratis from the New York State Department of Environmental Conservation in Albany, New York, and given to both Enfield and Danby schools. The majority of these articles were double-page, center-spread articles, featuring excellent colored pictures of plants, wildlife, wildlife habitats, and the like, and were suitable for student use and/or bulletin board display purposes.

Included in the supplementary materials were nine paperback books from the Golden Nature Guide series, intended for use by the instructed students in their science rooms and/or classrooms. The supplementary materials packets also contained thirty-one 30 to 35 page booklets, covering a wide variety of conservation, ecology, biology and natural history topics. Most of these booklets were copies of Cornell Science Leaflets, Cornell Rural School Leaflets, or New York State College of Agriculture Extension Bulletins. The majority of these informative booklets were received gratis from the Cornell Publications Mailing Room, at Cornell University's Research Park. The remainder of the booklets, and the paperback books, were purchased from project funds.

Hardware equipment for development and instruction

Instructional hardware equipment used in both the design and development phases, and in the implementation of this program, were borrowed from the Shell Merit Program or from the Elementary Science Project, both in the Division of Science and Environmental Education at Cornell, or were purchased by the author with project funds from the U. S. Office of Education.

Expenditures for development and evaluation

The cost of all materials, supplies, and equipment used in the design, development, replication of three final copies, and evaluation of the instructional lessons, including all lesson software and some lesson hardware (the slide viewer-magnifiers and slide boxes), came to a figure slightly in excess of nine hundred dollars. This amount, apportioned equally to three copies of the program, comes to slightly over three hundred dollars per program copy.

CHAPTER IV

PROGRAM IMPLEMENTATION

Early stages of program implementation

The implementation of an instructional program of any type requires the coordinated, and usually sustained, efforts of a number of people. Many people were instrumental in the implementation of this program, not the least of them being the students who attended the lessons and field trips, and the Northeast Elementary School fifth and sixth grade students who consented to take some of the tests without the prospect of receiving the audio-taped instruction or attending the post-lesson field trips.

Implementation of this study began with the efforts of Professors Richard B. Fischer and Joseph D. Novak of the Division of Science and Environmental Education at Cornell University, Mr. Irvin E. Henry, and Messers Edward S. Witko and Richard Solomon of the Tompkins-Seneca-Tioga Counties Board of Cooperative Educational Services at Ithaca, New York, and Miss Ann Gunning and Messers Donald R. Burdick and John Wertes of the Ithaca School System. Upon the U.S. Office of Education' approval of this research project, at a time when the author was in the state of Iowa gaining experience as an upper elementary school science teacher, the above people joined in a co-operative effort which culminated in the choice of the fifth and sixth grade students of Danby and Enfield schools as the instructed students of this study.

Program implementation was continued by the author upon his return to Ithaca, New York, in mid-June 1970. Implementation activities of the summer of 1970 consisted of meeting with the above people for purposes of clarification of some of the details of the planned program and establishing procedures by which project funds could be most efficiently administered. The author then met again with two of the above personnel, the Danby and Enfield principals, and with them investigated potential field trip sites and building facilities at the two schools.

I think it is appropriate to point out here, the fact that the science teachers, classroom teachers, and learning-center teachers of the two schools were, to my knowledge, minimally involved in the early planning and discussion related to this study. I do not believe that they were uninformed, in the late spring of 1970, of the intention of their schools to participate in this study, however.

I believe that it is also important to inform the reader that at no time did the author knowingly make any effort to "sell" the goals or processes of this environmental education program or any environmental education program to the teachers of either school. The author had no desire to bias the evaluation of this study directly through his efforts, or indirectly through his influence upon the teachers involved with the instructed students.

Communications with school staff personnel

If a characterization of the author's communication efforts and program implementation efforts with school personnel prevailing throughout the eight and one-half months of this study can be made, it was the author's conscious attempt to refrain from any interference with normal classroom and school procedures, practices, schedules, and goals. I believe that this "non-interference" policy generally benefited the implementation of the environmental education program, and contributed to the co-operation extended to the author by the teachers. Not all of the effects of this non-interference policy were however, of benefit to the goals of the instructional program. A discussion of this point will be made in the following chapter on the evaluation of the program of instruction.

During the second week of school in September 1970, the author met with the science teachers, the fifth and sixth grade classroom teachers, and the learning-center teachers of Danby and Enfield schools, and later the same week with all classes of the fifth and sixth grades of the two schools. A discussion of these implementation activities will begin with the school staff meeting, and a discussion of the meetings with students will follow later in this chapter.

In the initial school staff meeting, the author explained the goals of the environmental education program, demonstrated a sample copy of an audio-taped lesson, discussed ways the lessons might be employed within the schools, and through an extended question and answer session, the group considered many other aspects of the program. With the recommendations of the school personnel, decisions of program implementation were reached on such matters as: (1) where the lessons would be placed in the schools, (2) how an efficient student use schedule might best be accomplished, (3) what staff member or members should be in charge of the supplementary teaching materials packet, (4) how student tests could best be administered, (5) who should be contacted in the event of mechanical difficulties with lesson hardware, and (6) what school scheduling arrangements might be made to facilitate the attendance of any and all interested staff members at the planned outdoor field trips.

The Danby staff decided that the audio-taped lessons should be placed on a desk in a fairly large storage-coat rack area within the sixth grade classrooms. In Enfield school, the lessons were initially placed in permanent student carrells in the library-learning-center room. At various times during the following months, the actual lesson sites were changed with the recommendations and agreement of involved staff members, so that the lessons were eventually housed, for a period of at least one seasonal lesson series, in each fifth and sixth grade classroom and each library-learning-center complex of each of the two schools.

Both school staffs found the author's student lesson use chart satisfactory. It was agreed that the teachers might have to provide the students with some assistance in remembering to record the dates they attended each lesson. A copy of the student lesson use chart is in the Appendix. It was further agreed by school staff members that because of the departmentalized class scheduling in both schools, the students could best be scheduled for lesson use during their longest class periods, the half-school day sessions they spent in their coreroom classes. (Coreroom classes being classes in which mathematics, reading and writing were taught by teachers herein simply referred to as "classroom" teachers). The choice of the order in which students were to attend lessons within each classroom was left to the classroom teachers. Most decided to allow students to attend lesson in alphabetical order at times when they were not involved in group activities. Other classroom teachers decided that their students should attend lessons only after they had, as individuals, completed their school-work for the morning or afternoon, and again only at times when they were not involved in group activities. Needless to say, the efficiency of lesson use in the classrooms of teachers who threatened students with school-work completion prerequisites, was greatly reduced. The lessons often sat idle for days during times when the lessons were designated to be used by such classes.

To facilitate efficient use of the audio-taped lessons, the author procured three additional sets of lesson hardware, thereby doubling the lessons available for use at both schools by allowing the concurrent use of consecutive lessons at each school. Given the opportunity, four students could attend one each of one to four lessons at the same time in Enfield School and two students could attend lessons at the same time in Danby school.

Only three copies of lesson software materials could be produced because of limited project funding. In order to efficiently utilize the available lessons, it was decided in both schools that the classroom teachers would follow a student lesson use schedule whereby a given teacher would send her students to lessons only on designated weekdays. Weekly class use schedules were drawn up for each school for the year and copies replicated for all teachers. Such scheduling resulted at one school, for example, in fifth grade students using the lessons on Mondays and Tuesdays, sixth graders using the same lesson copies on Thursdays and Fridays, and both or neither using the lessons on Wednesdays (a shortened school day in the Ithaca system) on a first come first serve basis.

In the initial staff meeting, the classroom teachers concluded, and all others agreed, that the planned student tests would best be administered in the classrooms by the classroom teachers. With the exception of the author's administration of one of the non-instructed students' tests, all tests were administered by classroom teachers or by substitute teachers. Also concluded in the first staff meeting were arrangements for the replacement of slide viewer-magnifier bulbs by classroom teachers and/or learning-center teachers. All other lesson hardware replacement and repair would be handled by the author. The author did find it necessary to resolder the terminal jack wires on several of the earphone sets, and structurally change the wiring of each of the slide magnifier-viewers during the year. The jacks of the remote transformer cords of the slide viewer-magnifiers were poorly designed and incapable of withstanding the number of hours of use required. The author remedied this by removing the cord jacks and soldering the wires directly to selected terminals within the bodies of the viewer-magnifiers.

The science teachers at both schools, several other teachers, and the principal of one school, expressed desires to accompany the students and the author on one or more planned field trips. Most of these people, plus other school staff personnel, did attend one or more of the field trips at later dates.

The author's role in implementing the instructional program with school personnel began in September 1970, lasted approximately two hundred fifty-six days, and ended in mid-June 1971. The activities followed this general pattern. The author transported all lesson materials to the schools and set up each of the lessons in places designated for their use. Four carrells providing two or more lessons were normally available for student use at Enfield School and two lesson carrells housing either two copies of one lesson, or most often, one copy each of two lessons, were usually available at Danby School. The upper elementary student enrollment at Enfield was almost double that at Danby, and twice the number of lesson copies and carrells were required for efficient lesson utilization at Enfield.

Program use by a special class

The double size of the Enfield enrollment is not reflected in the group size (N) designations of the tests results and other tables of later chapters and the Appendix, because a number of the Enfield students did not participate in program testing. A special class of educable and/or slow learning children of upper elementary school ages attended special classes at Enfield School. The number of students in the special class remained about twenty during the course of the study. These children attended both the audio-taped lessons and the field trips but were not involved in the testing program because of suspected test-anxiety that might result from this activity.

Although no evaluation of learning outcomes of these students was attempted, the author frequently observed their behavior while he listened to the lessons with them, employing for this operation, a second set of earphones and a multiple jack system from the lesson tape recorder Upon completion of the lessons, the author usually chatted with the students, and as he did so with the students from the special class, it seemed clear that many of these children gained little conceptual information from most of the lessons. It was equally clear, however, that they very much enjoyed the lessons. Because these children were instructed by two well-trained and dedicated staff members, they were allowed to choose various activities during the coreroom half of their school day, with more freedom of choice than is generally allowed in upper elementary school classrooms. They were, for example, allowed to attend the audio-taped lessons a second or third time -- an opportunity that a number of them took. It may also be of interest to the reader that most of the students from this group were among the most active participants of the seasonal field trips.

Observation of students attending lessons

For the purpose of implementing the program, the author traveled to both Enfield and Danby schools from one to four times each week during the duration of this study. On some of these visits, the author consulted informally with school personnel about the program and about a wide variety of other matters. I would characterize these informal meetings as friendly and mutually beneficial. On most of my visits to the schools, I visited the lesson carrells for purposes of observing student lesson-use and ascertaining lesson-use frequency and lesson replacement demands. The primary purpose of this activity was, however, for observation of student behavior while they attended the lessons and for brief and informal "inquiry" sessions with the students following their completion of the lessons. The use of the information derived from these activities in final lesson revision has already been discussed. To facilitate any necessary lesson revision early in the lesson's use, lesson installation times were planned by the author for times when he would have sufficient time available to adequately assess the reactions of the first three or four students attending the lessons from each school. I note here, and will discuss it further in the following chapter, that the most likely candidates for early attendance at lessons were the top academically achieving students from, eventually, most classes.

The observation, inquiry interview, and check list of students' behavior and responses analysis of early lesson attendance resulted in minor revisions of five or the ten audio-taped lessons. All such revisions involved rewriting of audio-scripts and retaping and duplication of final tape cassettes.

In the initial, pre-program meetings of the author with the eight classes of instructed students, such matters as the following were considered and discussed: (1) an explanation of some of the goals of the environmental education instructional program, (2) the role the students could play in the design and development of the program, (3) a brief demonstration of lesson hardware equipment and selected typical lesson software materials, (4) explanations of the kinds of field trips that were planned to follow the three seasonal programs, (5) an explanation of possible student-use of the paperback books of the Golden Nature Guide series placed at that time in the science rooms of the classes, and (6) an extensive demonstration of the use of the student lesson use chart that was planned to aid in monitering student use of the audio-taped lessons. A student question-and-answer period was a part of all pre-program visits and all subsequent visits by the author to their classrooms or science rooms.

Implementation of outdoor field trips

Another kind of group meeting of the author with the instructed students, relevant to this discussion, was the pre-field trip meeting. Pre-field trip meetings were conducted in classrooms and/or science rooms prior to each of the field trips. The primary objective of these meetings was to help insure that the children would be properly dressed while on the field trips. No attempts were made at these times to cognitively prepare the students for field trip activities. Such preparation was left to the audio-taped instructional programs. The author's experience in conducting field trips with groups ranging in age from kindergarten to adults prepared him to anticipate the need of providing extra field trip clothing, and he provided numerous accumulate mittens, boots, scarves, sweaters, some heavy shirts, jackets, and caps for each group field trip for both the autumn and winter trips. Almost all of these articles of clothing were used by students of each group on both the autumn and winter field trips.

Parental-consent forms, required for each student for each field trip by one school, were developed by the school and distributed to the students by their classroom teachers a few days in advance of the field trips.

The author led each of the approximately sixty-four group field trips that occurred during the duration of the program. The field trip groups ranged in number from eight to twenty-six students, with the number primarily dependent upon the time of scheduling of each group trip. Field trips scheduling was done with the consultation of school principals, science teachers, and classroom teachers, and the author's previously discussed "non-interference" policy dictated in part the timing of the field trips. As many as eight separate small group field trips were conducted for a given seasonal field trip program for a given class. As was pointed out earlier, a number of school personnel accompanied the students and the author on many field trips, and the science teachers of both schools and the principal of one school activel participated in conducting some of the field trips.

Implementation in the non-instructed school

Also considered as implementary activities of this study were the author's communications with the principal, assistant principal, and selected upper elementary classroom teachers at Northeast School, a suburban elementary school of the Ithaca School District. Upon the author's request, some of the fifth and sixth grade students from this school attended tests one, three, and five, of the testing program. The participating students were chosen by the classroom teachers and tests one and five were administered by the same classroom teachers. The author administered test three.

Due in part to the rather flexible class programing at Northeast School, the actual students who participated in the tests varied from test to test. Some students were involved in all three tests, others in two tests, and others in one test. The author feels that this situation limited the usefulness of these non-instructed students' test question responses as control comparison responses. Also limiting the control function of the non-instructed students' responses was the author's inability to gain adequate descriptive information concerning the amounts and kinds of environmental education instruction received by the variety of students in their classrooms. The author is very grateful to the students and staff at Northeast Elementary School for their participation in this study, and he appreciates that their participation, without the opportunity to experience the program, was somewhat of an instrusion on their time and activities.

CHAPTER V

PROGRAM EVALUATION AND FINDINGS

Introduction

At the time this study was proposed, and continuing throughout the study, the author was aware of and frequently reminded of the difficulties and dangers of assigning causes, instructional or otherwis to ascertained information about peoples' knowledge, attitudes, behavio skills, and the like, and of the further hazards of assigning reasons to changes in such kinds of information over time. It is true that the varieties and numbers of events that influence the thinking and performance of people are enormous. Studies of the events and objects tha influence human performance are much more difficult to design and condu than are investigations of, for example, the performance of particles or microorganisms.

Considerations of the difficulties and constraints inherent in studies of human performance have resulted in few attempts to evaluate educational endeavors of a dimension larger than the teaching of a limited number of concepts, facts, or skills. Most of the studies that have been conducted have involved groups seldom larger than a few dozen individuals. Tightly controlled studies involving large numbers of learners are indeed rare. As the author indicated earlier in this thesis, attempts must be made to assess the learning outcomes of any and all instructional materials that are offered to the public in the guise of effective teaching materials. Because of the difficult of such endeavors, possibly the best that current investigators can hop to attain is a picture of what would-be learners know and feel about specific information prior to instruction, and by careful and long-term reassessment, slowly determine what aspects of instructional materials and/or procedures most influence the learners' beliefs and behaviors. This kind of evaluation cannot occur in the brief span of one or a few months or years. But it must be attempted. With current and future generations of computers, computer-assisted program evaluation projects should be capable of, and in the opinion of the author, must be so employed, to elucidate the effects of instructional processes and materials employed in our schools and elsewhere.

Most instrumental in the evaluation efforts of this study was the advice of Jason Millman, Associate Professor of research methodology in the Department of Education of the New York State College of Agriculture at Cornell University, and the writings of J. P. Guilford (1965) of the Department of Psychology at the University of Southern California. Any and all deficiencies in the evaluation procedures and the interpretations of findings reported herein must be assigned to the author, rather than to the advice or the statistical and methodological writings of the two aforementioned professors.

Pre-instruction lesson evaluation

Discussed earlier were the frequent but brief author-student interviews employed immediately after the students' attendance at the ten audio-taped lessons. The reader may recall that the intent of these interviews was to ascertain any major deficiencies of the lessons in order that such deficiencies might be rectified prior to the attendance of most of the students at the lessons. Unbeknown to the author during the autumn program and through most of the winter program, the early attending students interviewed were largely the top academically achieving students of the instructed students' classes. In no sense did they constitute a random group in terms of their academic abilities. Interviews with them undoubtedly under-estimated the numbers and kinds of deficiencies of the instructional materials. Most teachers apparently discovered early in the program the motivational value of the lessons, as those who finished their school work early were in almost all cases the first students allowed to attend newly installed audio-taped lessons. Both teachers and students views of the lessons as instruction that was "special" and most probably adjunct to the "regular" school instructional activities was unfortunate.

Evaluation of supplementary instruction

Throughout most of the program, the majority of the classroom teachers and learning center teachers referred to the program as the "science program", the "enrichment program", or the "science-enrichment program". Science teachers also apparently viewed the environmental education program as adjunct to the normal curriculum of their schools. They most commonly referred to the program as the "A-T program" or as "Mr. Presnell's" program. The two principals on the other hand, indicated by various means that the program was in their opinions, an integral part of the school program.

Much of the blame for what the author feels was a situation detrimental to effective program development, implementation, and to some degree program evaluation, can be placed on the lack of involvement of all participating teachers in the initial planning phases of the program. There may well be questions as to the kinds of roles teachers can play in supplementing a program of this type. But there can be no question as to the necessity of teacher involvment in decisions whether and how new instructional programs should be employed in their schools.

The supplementary teaching materials described on pages 34 and 35, intended for use by any and all teachers and/or students contributed little if any to this program. One science teacher reported using many of the booklets for personal information, and others may have so used them, but with the exception of some of the paperback books of the Golden Nature Guide series used in some post-field trip group activities in the spring, the supplementary materials did little more than take up space among the schools' supplies of science equipment. The lack of use probably should be attributed more to the science teachers' "hands off Mr. Presnell's program" attitude than to deficiencies inherent within the supplementary materials.

The teacher's adjunct characterization of this program most severely affected learning outcomes through the teachers' unconscious manifestations of their feelings, I believe. Students too, commonly behaved in ways that indicated they felt the audio-taped lessons and field trips were adjunct to their schools' normal programs. Possibly the program's new and novel approach to instruction was the primary cause. Although other lower elementary students and teachers in both schools had both previous and current experience with the audio-tutorial science lessons of the Elementary Science Project, students and teachers participating in this study had not had such experience. Possibly also atypical was the author's concern with assessment of the instructional materials. The author had excellent rapport with both participating students and teachers throughout the duration of the program, but all his inferences, designed to have them consider the program as "their" program, seemed futile.

Most, if not all of the teachers, and most of the students also viewed the instructional program as one of the great educational worth. I attribute this view, at least in part, to the commonly held misconception that any instructional materials, sanctioned by a school district and employed in schools, are of educational worth. The following discussion of the findings of the school staff questionnaire will, I believe, support my opinion.

The role of the school staff questionnaire in evaluation

The reader will find a copy of the school staff questionnaire in Appendix II. The purpose of the questionnaire was to assess the participating teachers' opinions about: (1) possible future utilization of the program (questions 1, 2, 3, 4, 5, and comments to other questions), (2) the effects of the program in their schools (questions 7, 8, 9, 10, 11, 12, and 21), (3) the importance of the content of the audio-taped lessons to the education of upper elementary school children (questions 16 and 19), (4) what, if any, problems were created in their classrooms by the program (questions 2, 3, 5, and other comments), and (5) what factors most limited efficient student use of the lessons (question 6). Further purposes of the questionnaire were to determine: (6) whether, and what kinds of teachers attended the lessons and/or field trips (questions 13, 14, 15, and 23), (7) what roles the teachers felt capable of, or willing to assume in conducting outdoor field trips with upper elementary school children (questions 24 and 25), and (8) what roles the science teachers and classroom teachers had played in supplementing the program, and via their comments, what roles they said or inferred they should play or have played in supplementing the instructional program (questions 17 and 18).

The school staff questionnaire was designed and produced by the author. It was distributed to the ten participating teachers via their school offices within a week or ten days prior to final student use of the final spring audio-taped lesson. To my knowledge, all teachers completed the questionnaire individually during their off-school hours over a period of two to five days. With the exception of two teachers who handed their response sheets to the author, the teachers' responses were retrieved via the school offices. The teachers were not asked to identify themselves on the questionnaire and in most cases they did not. However, the author's year-long acquaintance with most of the teachers made it difficult not to identify all staff members by their comments to various questions. It should be noted here that although all teachers who actively participated in the implementation of the program were surveyed, not all of them had particpated for the full duration of the program. One learning-center teacher played a role in the program only during the duration of the spring lessons. One classroom teacher replaced another who left the school district at mid-year, and who was not available for inclusion in the survey. A second classroom teacher, who was a frequent substitute teacher in one of the schools, replaced a full-time teacher who took a leave of absence from the school midway in the spring program. Both the teacher who left and her replacement received questionnaires and responded. All teachers who received copies of the questionnaire responded.

The author systematically analysed the questionnaire responses using a check-list approach for the "yes-no" responses, and he recorded all teachers' comments exactly as written. The reader's attention is directed to the final eleven pages of Appendix II for a detailed accoun of the questionnaire and the teachers' responses.

The findings of the school staff questionnaire

The findings of the questionnaire, as interpreted by the author are as follows:

1. On the subject of future use of the program in the experimental schools, ninety to one hundred per cent of the teachers felt continued use was worthwhile and that they could, with few problems, implement the audio-taped lesson aspects of the program. Responses to question four indicated that most felt the lesson carrells should be placed in the coreroom classrooms. The learning-center teachers and the only teacher (special class) who did not have the carrells in her classroom during the year, felt that the carrells would best be placed in the learning-centers.

2. In response to questions pertaining to the "effects" of the program one hundred per cent of the teachers wrote that the students enjoyed the program. I agree. All of the teachers responded to question eight, which unlike most questionnaire questions of most questionnaires, asked for evidence of learning outcomes. With the exception of one science teacher who is able to verify numerous instances of students having employed learnings from information of the kind found in the audio-taped lessons, none of the teachers offered more than opinionated "evidence" to support their general feeling that the children "learned". The teachers' inability to offer better statements of evidence, reflects both the teachers' failure to become involved in the program and the reflection of thi failure in the attitudes of their students. It further supports my argument that teachers, like most adults, generally assume that most any kind of instruction results in learning. I am thankful that today's students are more discerning.

An analysis of the evaluative tests, occurring later in this chapter, will indicate that some learning did indeed occur. Some of this learning may be attributed to the instructional program. Additional questions to ascertain the teachers' opinons as to the effects of the program indicated that ninety per cent of the teachers believed the students' ecological and/or conservation literacy had improved, as indicated by the students' use of words and ideas from the lessons in conversations with them. A majority of the teachers also wrote that the students used lesson ideas and vocabulary in conversations with each other. None of the teachers could recall students' parents having discussed the program with them. This may be a positive indication of the parents' view of the program, as most teacher-parent discussions concerning school programs are directed to programs which either the teachers or the parents feel are unsatisfactory. Eight of the ten teachers responded that the winter wildlife ecology game was both an enjoyable experience and a learning experience for the students. It should be noted that the remaining two teachers had no experience with the students' use of the game. I concur with the teachers' opinions as to the students enjoyment of the game, and feel, after a number of hours observing them playing the game, that they did indeed learn much about the habits and habitats of the animal species they as players represented. I have no evidence to support statements of learning outcomes that could be attributed to the wildlife ecology game, however.

3. By their answers to question nineteen, all responding teachers indicated that they believed the content of the audio-taped lessons should be included in upper elementary school instruction and eight or nine of the nine who responded to this question, the actual number dependent on interpretation of a comment, indicated that they learned things in the audio-taped lessons that they felt were important to the education of their students. The disparity between the teachers' professed beliefs in the importance of such instruction and their actual efforts to supplement it may be the result of feelings that they were insufficiently trained in teaching notions of ecology and conservation, coupled with the fact that what they considered effective instruction was being offered. The author feels that another contributing factor to this disparity was a general feeling that all responding teachers believed they had more important duties to perform, and therefore had no classroom time for either offering or supplementing such instruction. Selected questionnaire comments and a number of author-teacher conversations lead me to this conclusion. Teachers -- like all people -- manage to devise ways of filling their hours with tasks that are or seem important to them.

I think that teachers who feel, as many do, that their teaching duties are both important and constitute a full or an excessive work-load, will have to be made highly "aware" before they will add environmental education teaching duties to their teaching efforts. This notion has serious implications for many environmental educators who believe that school environmental education programs must, to be effective, either: (1) rely on the efforts of "aware" teachers offering such instruction within the framework of existing school schedules, and/or (2) must permeate all school subjects at all grade levels. If the goals of environmental education are to be achieved in schools, an entirely new sort of teacher training effort will be required -- and/or new kinds of instructional materials must be devised.

4. With the exception of some burned out light bulbs and worn wires in some earphone sets, which obviously constituted a threat to one teacher, the program created no substantial problems in the class-rooms. The author anticipated some comments to questions three or six, relating at least some minor problems of classroom group activities having been interrupted by student use of the lessons, but no such responses were received.

5. The responses to question six, pertaining to factors most responsible for regulating student lesson use were much as anticipated. The most frequently listed comments indicated that the departmentalized schedule of both schools, and the departmentalized program itself, were the primary factors. Many teachers, on other occasions, indicated their dissatisfaction with departmentalized scheduling for upper elementary school children, and even more so for lower elementary school children. Most of these teachers feel that such scheduling generally interferes with effective instruction within their schools.

6. I feel that responses to question thirteen, which asked the teacher whether they had listened "through" any lessons, may not be reliabl The teachers may have misinterpreted the question as asking whether they had listened "to" any audio-taped lessons. Eight of ten responding teachers claimed to have listened through some lessons. I feel that the mean number of lessons completed for the different kinds of teachers does correctly reflect the science teachers' greater personal use of the lessons. Responses to question twenty-three, about teacher attendance at field trips, give an

accurate picture. None of the learning-center or classroom teachers attended any field trips prior to the questionnaire. One classroom teacher attended a portion of a post questionnaire late spring trip, and another classroom teacher, in poor health throughout much of the school year, and in the hospital at the time of the spring trips, would have attended all trips had she been in better health. The science teachers commonly accompanied the students and the author on field trips. One principal, well-trained in biology, also accompanied groups on some trips and played an active role in conducting some of his school's winter field trips.

7. The teachers' "conditioned" comments to questions twenty-four and twenty-five offer some insight into a reason why these teachers and many others I expect, hesitate to lead outdoor field trips. The prospect -- and possibly the past experience -- of taking "large" groups of children on outdoor field trips is frightening to many teachers. The outdoors provides no walls, desks, and other normal classroom fixtures that serve as "clues" to maintain group control. I refer here to the "small group" conditioning comments. All indications from conversations with the participating teachers were that "small" groups are a prerequisite to willingness to conduct field trips,not because group size per se enables teachers to more effectively conduct trips and perform whatever leadership and instructional duties they feel the position requires, but rather because small groups can more easily be controlled outdoors. Although this is a fact, I must add that very few of the instructed students, even under some relatively "large" group field trip conditions, required much "control". The novelty of a "special" teacher rather than one of their regular classroom or other teachers as trip leader played a part in student control in this instance.

Considering the responses to questions twenty-four and twenty-five indicating that half of the classroom teachers considered themselves capable of conducting field trips, and all of them willing to do so, it is somewhat difficult to reconcile the fact that none did become actively involved in the field trips. One might attempt to account for this with an argument that the classroom teachers felt obligated to remain with the portion of their classes that were not attending the trip at that time. Sometimes only portions of classes comprised field trip groups. This may be a valid argument. However, the principals of both schools sincerely offered to replace or find replacements for the classroom teachers, to facilitate their attending the field trips. Inclimate weather, which was present for a few trips, might consitute a valid explanation for non-attendance for many, and must for a few classroom teachers. The expressed need (question twenty-five comments) by one classroom teacher and one learning-center teacher, for training in conducting field trips offers some insight into the lack of field trip attendance. Two classroom teachers and the learning-center teacher responded to question twenty-four that they were not capable of conducting field trips. But the reader is reminded that six of ten teachers responded to this question in a manner to indicate they felt they were so qualified, and five of the six responses were unqualified "yes" responses. Without a doubt, a teacher must feel capable of leading outdoor field trips in environmental education before he will lead them. But in this instance, I believe that the teachers' view of the environmental education program herein described as being adjunct to their school's program, or possibly, that they considered themselves to be adjunct to the environmental education program, constitutes a more correct interpretation of the reasons for their failure to attend the outdoor field trips.

The student tests in evaluation of the program

Following is first a discussion of the assessment procedures and analysis of derived data relevant to objective seven of this study--the evaluation of selected student learning outcomes of the audio-taped lessons -- and second, a discussion of the findings as condensed in tables one through fourteen and depicted in figures one through fourteen occurring later in this chapter.

Five student tests, each asking students twelve questions which required fifteen responses, were administered at various times prior to and after instruction and/or field trips. The actual times of instruction, field trips, and testing are reported in the Table of Program Events and Time of Events and the end of Appendix I. The times of each program event for each participating class are given in days-post test one. Test questions were of two types: some questions were used only for pre-instruction student knowledge assessment but most questions were repeated one or more times on different tests, and served to indicate both pre-instruction and post-instruction and/or post-field trip student information. All questions were intended to assess cognitive rather than attitudinal information, and all questions asked that the students produce the answer in writing or drawings. Accurate facsimiles of all tests, test administration directions, and student response booklets are in Appendix II. The reader may recall that all test administration, with the exception of the author's administering test for to non-instructed students, was performed by the students' classroom teachers and/or substitute teachers.

The author scored all tests of all students after designing hierarchical response grouping categories for conceptual questions and response scoring criteria for factual questions. Details of each question's response category criterion and/or score criterion are given for the various tests and their questions in Appendix II under the heading, "Students' Responses to Test Questions". In general, groups were ranked and defined such that the most generalizable, most sophisticated, and/or most scientifically correct answers were placed in the highest ranked response group, which was identified with the number one for all questions of a conceptual nature. Poorer responses were placed in lower response groups, labeled with consecutively higher numbers. Students who failed to answer a question of this type, or in some cases, those who either failed to answer the question or gave selected poor answers, were placed in the lowest response group, which was labeled with the largest number of the response group identification numbers for the question.

Factual questions, usually asking the student to list a number of objects, behaviors, or events, were scored in the following manner. All answers considered to be correct by the author were given a value of one, and all incorrect answers were given a value of minus one. A given student's score for each such question was derived by simply adding the positive and negative scores assigned to each part of his response for the question. After some necessary refinement of the response grouping criteria and score criteria in the early analysis of test one responses, very few student responses given to test one questions and to later test questions were found difficult to categorize.

Standard eighty space coding forms were used to record all responses of all students. Two coding form lines were given to each student and all students were identified on the coding forms by a three digit number, with their specific classes and schools identified by two digit numbers. Time of all program events were also recorded for each student, using the three digit "days post-test one" system employed throughout the study for time designations. All students could hence be identified as to attendance at any or all program events.

The response group identification labeling, having low numbers identifying best answers and high numbers identifying poor or no answer responses, was found to be deficient for score analysis purposes. The following procedure was employed to assign score values to students' answers. The original response group identification and categorization system can be characterized as a reverse ordinal scale. The score value system employed in data analysis involves scores that are ordered on a continuum from low numbers (poor answers) to high numbers (better answers) and can be considered a normal ordinal scale.

A score of zero was assigned to all responses in each question's highest response group. Consecutively lower response group answers received consecutively higher score values at whole number intervals. Using the students' responses to question two, test one as an example, those students who failed to answer the question were recorded in response group 3 and received a score of zero; those who gave answers of response group 2 quality received scores of one; and those whose drawing were most correct and were, therefore, recorded in the best response group, group 1, received scores of two for this question. In like manne scores were assigned to all students' responses on all tests they attended. Arithematic means, variances, and standard deviations for all classes for all questions of the five tests were derived using a Wang 360 electronic calculator.

Analysis of changes in instructed students' responses to test questions was performed with the aid of the same calculator, using Fischer's t test for significance of correlated means (Gilfrod, 1965, pages 177-185 and 580-581). The scores of all students who attended each of any two consecutive tests and the lessons and/or field trips tha intervened, could be and were used in this analysis. A comparison of each student's initial score with his later score for each repeated test question was required. The following formula for Fischer's t test of correlated pairs of means applies to the analysis used to investigate students' changes in responses over the period of this study.

$$t = \frac{M_d}{\sqrt{\frac{x_d^2}{N\ (N-1)}}}$$

t = Fischer's t for differences between correlated pairs of means

M_d = The mean of N difference of paired scores

x_d = The deviation of the differenc for the mean of the difference

N = The number of students in the group

Changes in students' responses to test questions occuring over the duration of the program

The following findings resulted from the analysis of instructed students' correlated means for selected reoccuring test questions. Due to variation in attendance of individual Northeast School students, discussed earlier, such an analysis was not possible for the noninstructed students' test question responses. A different analysis, comparing instructed and non-instructed students responses to these questions was employed and is discussed later in this chapter.

The null hypothesis for all four groups' mean score changes for each question analysed was that there would be no significant change in mean score over time. Levels of rejection of the null hypothesis for the two tailed t tests employed were .025 for "significant" changes and .005 for "very significant" changes in mean scores. The instructed students' mean scores to selected reoccuring conceptual and factual test questions are tabulated on tables one through fourteen and graphically illustrated in corresponding figures one through fourteen on pages 46 through 59. Inspection of the tables and graphs will indicate that the mean scores of most groups of instructed students generally increased over time.

Tables one through seven and figures one through seven pertain to a variety of questions that were used on the pre-program test (test one), on the post-program test (test five), and one or more intervening tests. The time span between tests one and five was two hundred, forty-two and two hundred, forty-five days for Enfield and Danby classes respectively. The topics of the information a assessed include such notions as: life requirement similarities of all living things, the role of the inclination of the earth's axis in seasonal temperature variation on earth, photo-periodism in plant and animal mechanisms, responses, and behaviors prior to winter, selected ideas of plant reproduction and plant anatomy, and the function of plant seed dispersal mechanisms. The topics are listed on both the tables and figures, and the specific test questions and test numbers are identified on the tables and may be found in the test facsimilies in Appendix II.

TABLE 1

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING MATERIALS AND LIVING CONDITIONS REQUIRED BY PLANTS AND ANIMALS

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}_1$	1.64	2.03	2.41	2.22
$\bar{X}_2$	2.48	2.42	2.84	2.23
$\bar{X}_5$	2.35	2.16	3.22	2.43
T_1	000	000	000	000
T_2	054	066	056	066
T_5	245	242	245	242
t_{1-2}	+2.317*	+1.934	+1.445	+0.583
t_{2-5}	-0.877	-1.409	+0.837	+0.604

$\bar{X}_1$ = Mean of students' response scores to question 1, test 1.

$\bar{X}_2$ = Mean of students' response scores to question 1, test 2.

$\bar{X}_5$ = Mean of students' response scores to question 1, test 5.

T_1 = Time of test 1 in days post-test 1.

T_2 = Time of test 2 in days post-test 1.

T_5 = Time of test 5 in days post-test 1.

t_{1-2} = t score for Fisher's t test for differences between correlated means for means of test 1 and test 2 scores.

t_{2-5} = t score for Fisher's t test for differences between correlated means for means of test 2 and test 5 scores.

* The difference in means is significant at less than the .025 level.

FIGURE 1

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO REPEATED TEST QUESTIONS CONCERNING THE MATERIALS AND LIVING CONDITIONS REQUIRED BY PLANTS AND ANIMALS

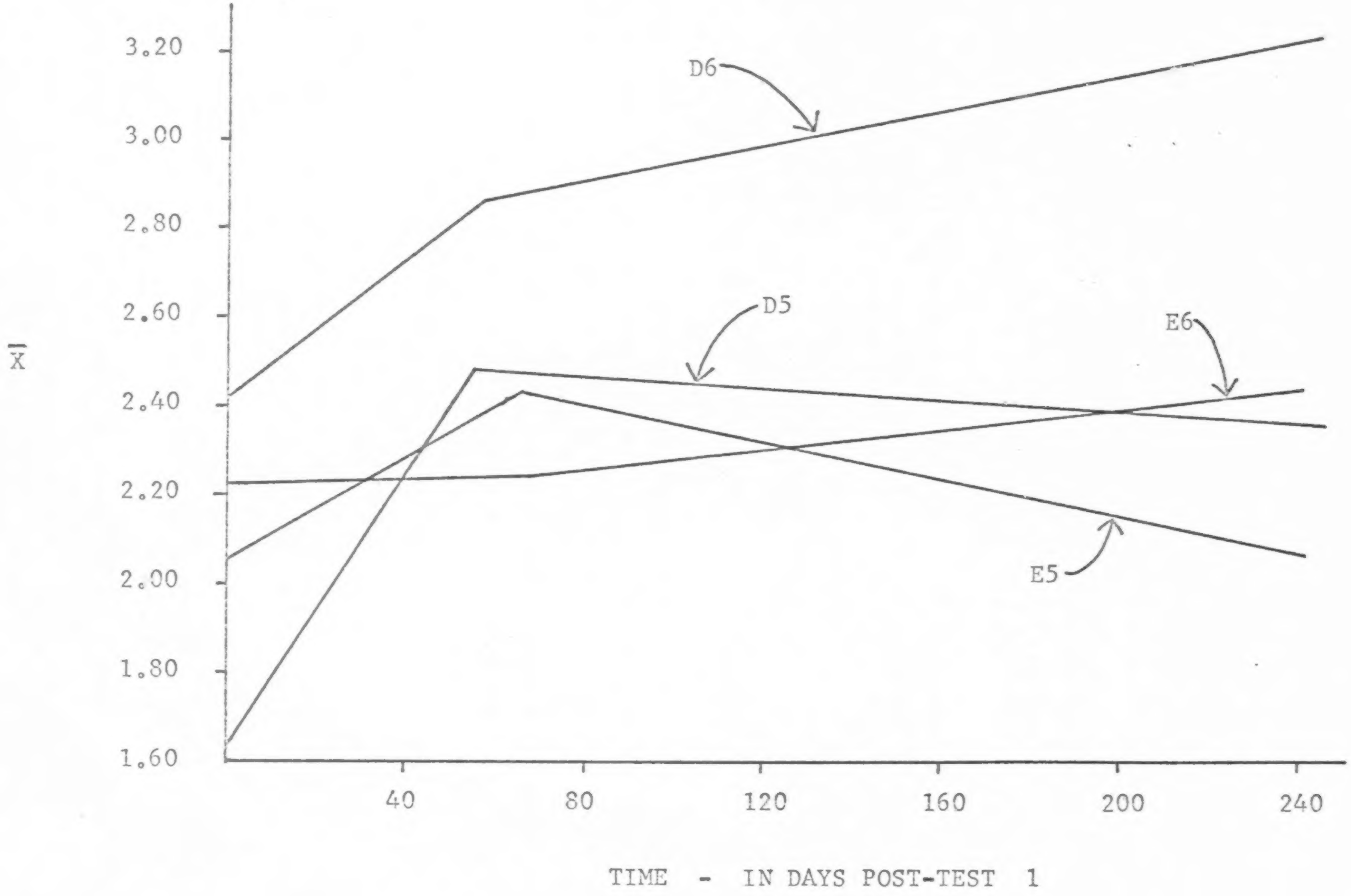


TABLE 2

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING THE PRIMARY CAUSE OF SEASONAL TEMPERATURE VARIATION IN THE NORTH TEMPERATE ZONE

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}_1$	2.00	1.60	2.11	2.48
$\bar{X}_2$	2.38	2.33	2.36	3.71
$\bar{X}_4$	2.25	2.41	2.82	3.24
$\bar{X}_5$	2.15	2.25	2.70	3.21
T_1	000	000	000	000
T_2	054	066	056	066
T_4	181	189	178	189
T_5	245	242	245	242
t_{1-2}	+0.984	+3.322**	+0.168	+3.232**
t_{2-4}	-0.134	+1.829	-1.451	-0.598
t_{4-5}	-0.773	-0.235	-0.008	-0.204

$\bar{X}_1$ = Mean of students' response scores to question 4, test 1.

$\bar{X}_2$ = Mean of students' response scores to question 4, test 2.

$\bar{X}_4$ = Mean of students' response scores to question 5, test 4.

$\bar{X}_5$ = Mean of students' response scores to question 2, test 5.

T_1 = Time of test 1 in days post-test 1.

T_2 = Time of test 2 in days post-test 1.

T_4 = Time of test 4 in days post-test 1.

T_5 = Time of test 5 in days post-test 1.

t_{1-2} = t score for Fisher's t test for differences between correlated means for means of test 1 and test 2 scores.

t_{2-4} = t score for Fisher's t test for differences between correlated means for means of test 2 and test 4 scores.

t_{4-5} = t score for Fisher's t test for differences between correlated means for means of test 4 and test 5 scores.

* The difference in means is significant at less than the .025 level.

** The difference in means is significant at less than the .005 level.

FIGURE 2

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING THE PRIMARY CAUSE OF SEASONAL TEMPERATURE VARIATION IN THE NORTH TEMPERATE ZONE

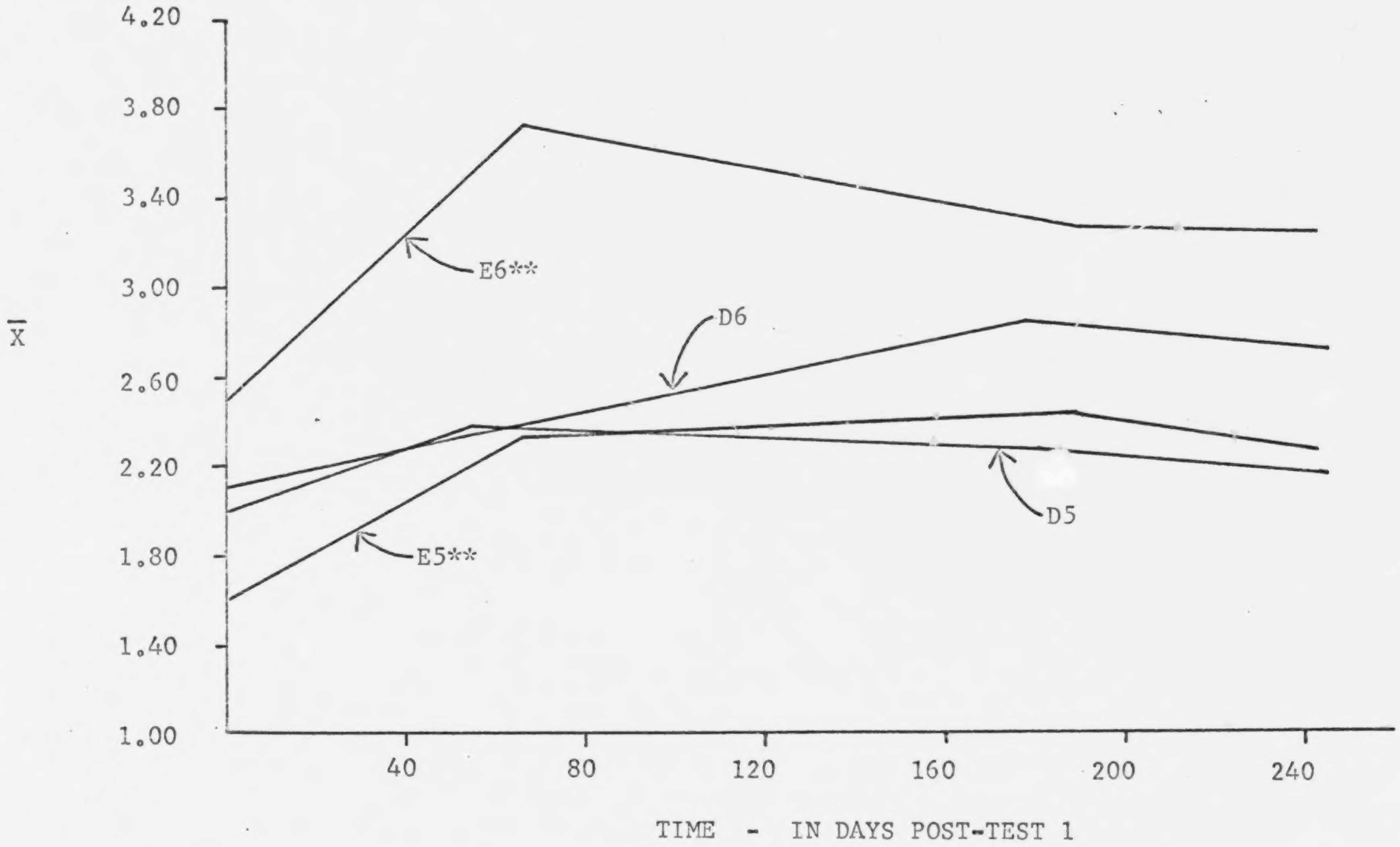


TABLE 3

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING ANIMALS' PERCEPTION OF ENVIRONMENTAL CLUES TO THE APPROACH OF WINTER

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}_1$	2.54	3.09	3.15	3.42
$\bar{X}_2$	4.05	3.11	4.04	3.74
$\bar{X}_5$	2.85	3.22	4.00	3.71
T_1	000	000	000	000
T_2	054	066	056	066
T_5	245	242	245	242
t_{1-2}	+3.782**	+0.087	+2.970*	+0.935
t_{2-5}	-2.617*	+0.617	-0.384	-0.152

$\bar{X}_1$ = Mean of students' response scores to question 8, test 1.

$\bar{X}_2$ = Mean of students' response scores to question 8, test 2.

$\bar{X}_5$ = Mean of students' response scores to question 5, test 5.

T_1 = Time of test 1 in days post-test 1.

T_2 = Time of test 2 in days post-test 1.

T_5 = Time of test 5 in days post-test 1.

t_{1-2} = t score for Fisher's t test for differences between correlated means for means of test 1 and test 2 scores.

t_{2-5} = t score for Fisher's t test for differences between correlated means for means of test 2 and test 5 scores.

* The difference in means is significant at less than the .025 level.

** The difference in means is significant at less than the .005 level.

FIGURE 3

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING ANIMALS' PERCEPTION OF ENVIRONMENTAL CLUES TO THE APPROACH OF WINTER

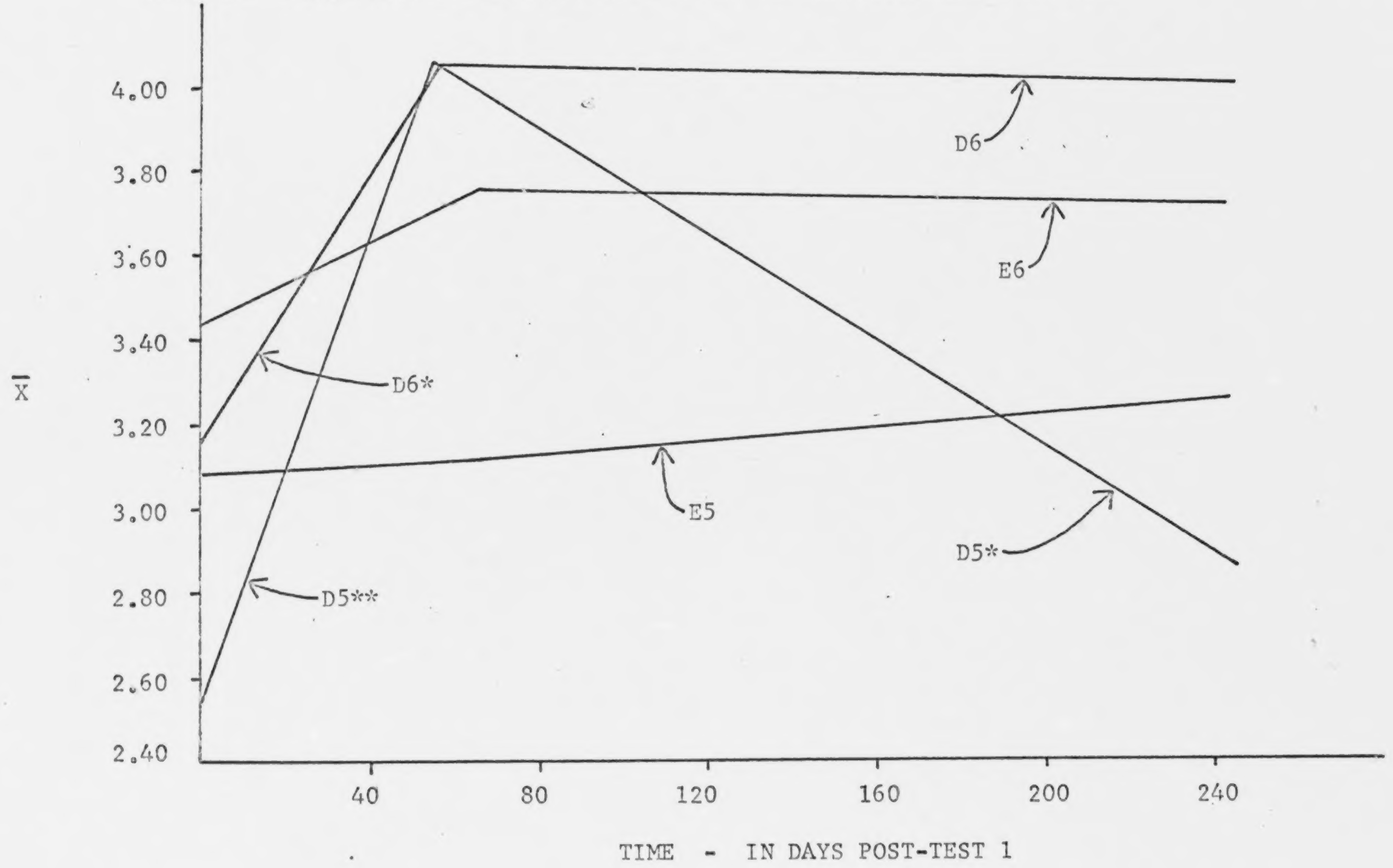


TABLE 4

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING THE POSITIONS OF BUDS ON A DIAGRAM OF AN ALTERNATE LEAVED PERENNIAL PLANT

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}_1$	0.50	1.02	2.07	2.12
$\bar{X}_2$	1.67	2.06	2.60	2.94
$\bar{X}_3$	3.15	1.88	3.00	2.91
$\bar{X}_5$	2.75	2.53	3.17	3.04
T_1	000	000	000	000
T_2	054	066	056	066
T_3	082	084	082	084
T_5	245	242	245	242
t_{1-2}	+3.589**	+3.213**	+1.141	+2.776**
t_{2-3}	+3.911**	-0.423	+1.207	-0.118
t_{3-5}	-0.497	+1.352	+0.143	+0.775

$\bar{X}_1$ = Mean of students' response scores to question 7A, test 1.

$\bar{X}_2$ = Mean of students' response scores to question 7A, test 2.

$\bar{X}_3$ = Mean of students' response scores to question 7A, test 3.

$\bar{X}_5$ = Mean of students' response scores to question 4A, test 5.

T_1 = Time of test 1 in days post-test 1.

T_2 = Time of test 2 in days post-test 1.

T_3 = Time of test 3 in days post-test 1.

T_5 = Time of test 5 in days post-test 1.

t_{1-2} = t score for Fisher's t test for differences between correlated means for means of test 1 and test 2 scores.

t_{2-3} = t score for Fisher's t test for differences between correlated means for means of test 2 and test 3 scores.

t_{3-5} = t score for Fisher's t test for differences between correlated means for means of test 3 and test 5 scores.

* The difference in means is significant at less than the .025 level.

** The difference in means is significant at less than the .005 level.

FIGURE 4

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING THE POSITIONS OF BUDS ON A DIAGRAM OF AN ALTERNATE LEAVED PERENNIAL PLANT

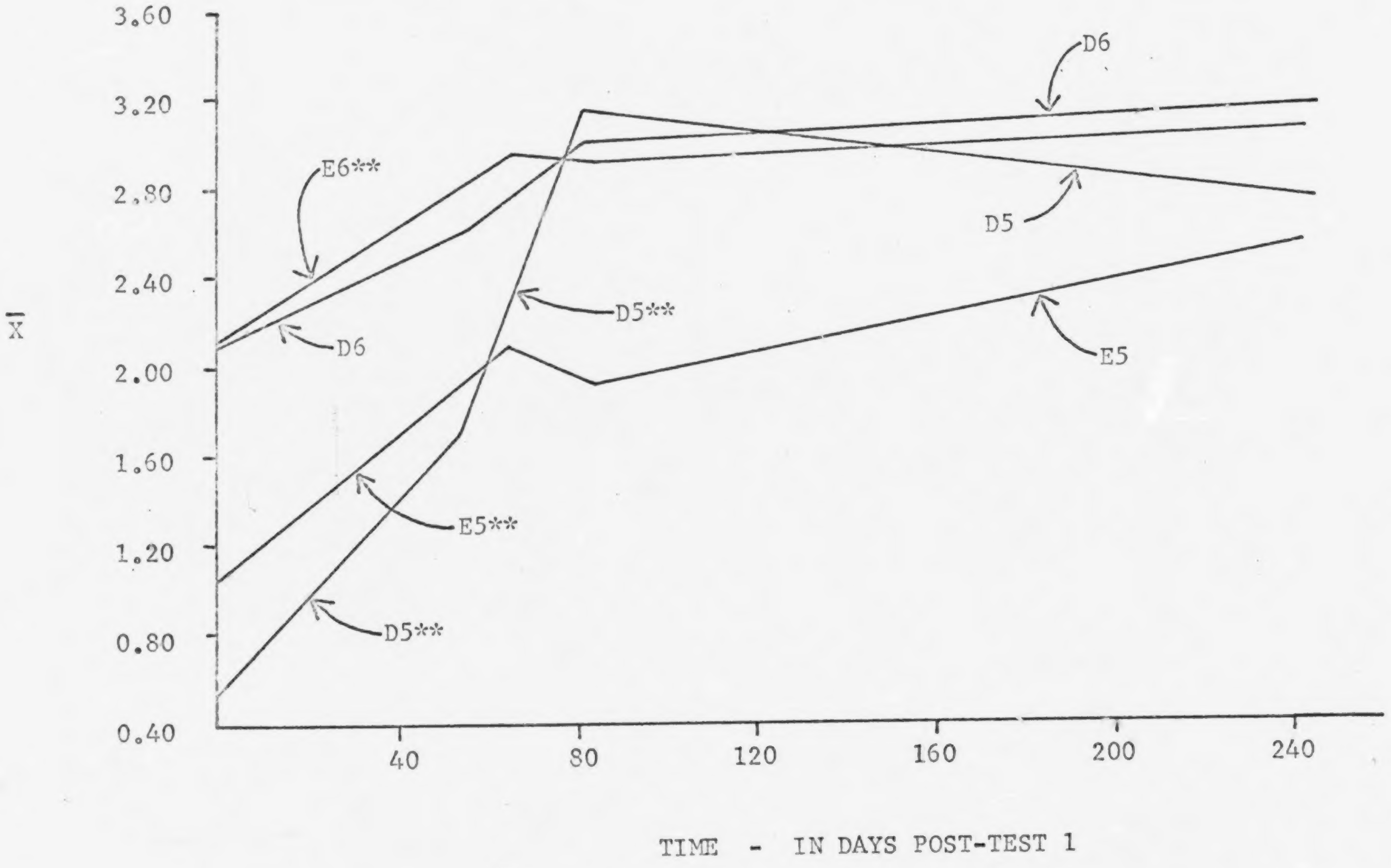


TABLE 5

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING THE FUNCTION OF SEEDS IN PLANT REPRODUCTION

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}_1$	1.50	1.54	1.78	1.94
$\bar{X}_2$	1.71	1.75	1.84	1.87
$\bar{X}_5$	1.80	1.75	2.00	1.71
T_1	000	000	000	000
T_2	054	066	056	066
T_5	245	242	245	242
t_{1-2}	+1.706	+1.234	+0.700	-0.999
t_{2-5}	+0.622	+0.078	+1.451	-1.544

$\bar{X}_1$ = Mean of students' response scores to question 9A, test 1.

$\bar{X}_2$ = Mean of students' response scores to question 9A, test 2.

$\bar{X}_5$ = Mean of students' response scores to question 6A, test 5.

T_1 = Time of test 1 in days post-test 1.

T_2 = Time of test 2 in days post-test 1.

T_5 = Time of test 5 in days post-test 1.

t_{1-2} = t score for Fisher's t test for differences between correlated means for means of test 1 and test 2 scores.

t_{2-5} = t score for Fisher's t test for differences between correlated means for means of test 2 and test 5 scores.

FIGURE 5

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING THE FUNCTION OF SEEDS IN PLANT REPRODUCTION

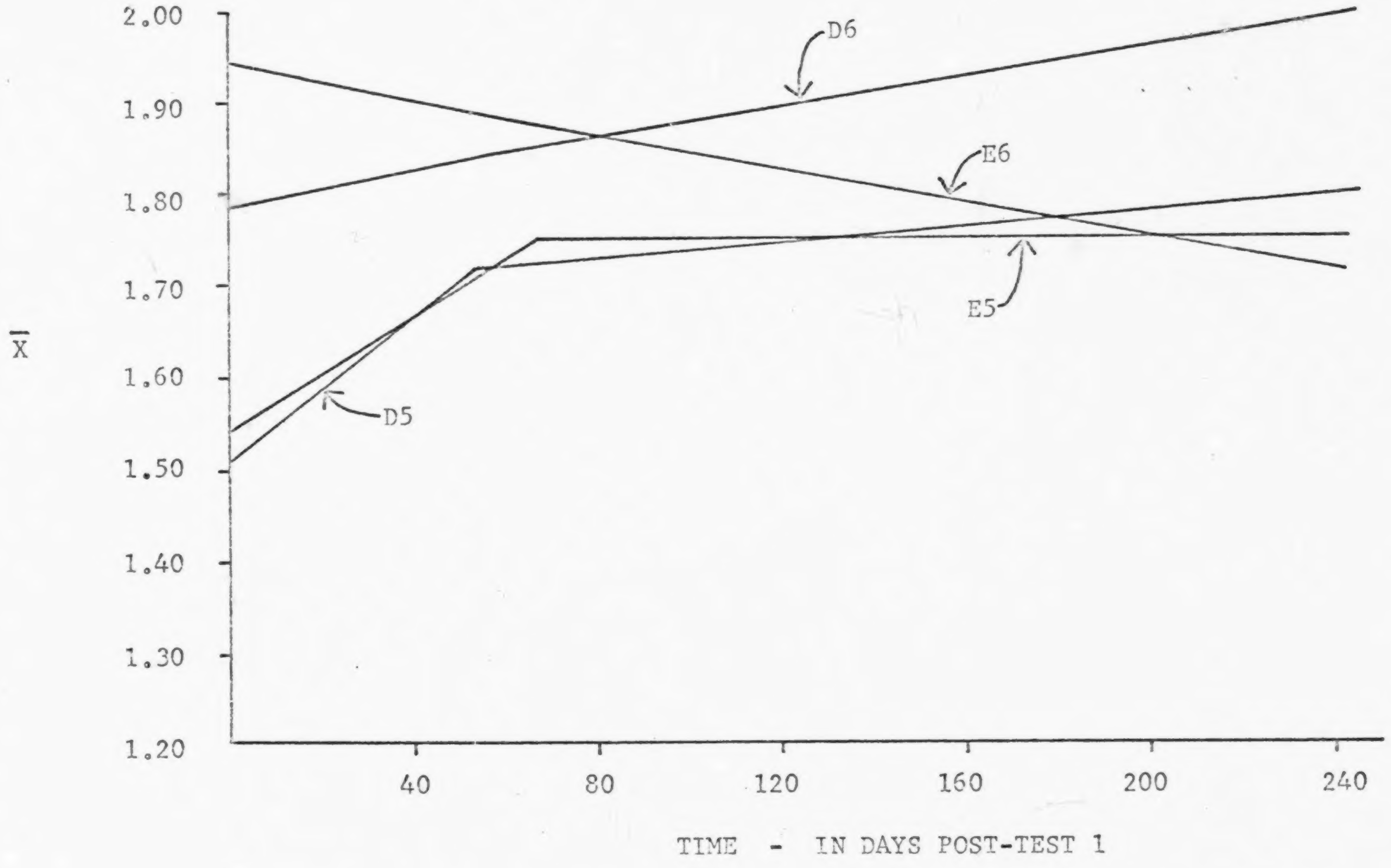


TABLE 6

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING SEED DEVELOPMENT IN FLOWERS AND CONES

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}_1$	0.86	1.06	1.00	1.39
$\bar{X}_2$	0.95	1.19	1.20	1.25
$\bar{X}_5$	1.05	1.13	1.17	1.29
T_1	000	000	000	000
T_2	054	066	056	066
T_5	245	242	245	242
t_{1-2}	+0.439	+1.277	+1.809	-1.072
t_{2-5}	+0.697	-1.976	+0.326	0.000

$\bar{X}_1$ = Mean of students' response scores to question 9B, test 1.

$\bar{X}_2$ = Mean of students' response scores to question 9B, test 2.

$\bar{X}_5$ = Mean of students' response scores to question 6B, test 5.

T_1 = Time of test 1 in days post-test 1.

T_2 = Time of test 2 in days post-test 1.

T_5 = Time of test 5 in days post-test 1.

t_{1-2} = t score for Fisher's t test for differences between correlated means for means of test 1 and test 2 scores.

t_{2-5} = t score for Fisher's t test for differences between correlated means for means of test 2 and test 5 scores.

FIGURE 6

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING SEED DEVELOPMENT IN FLOWERS AND CONES

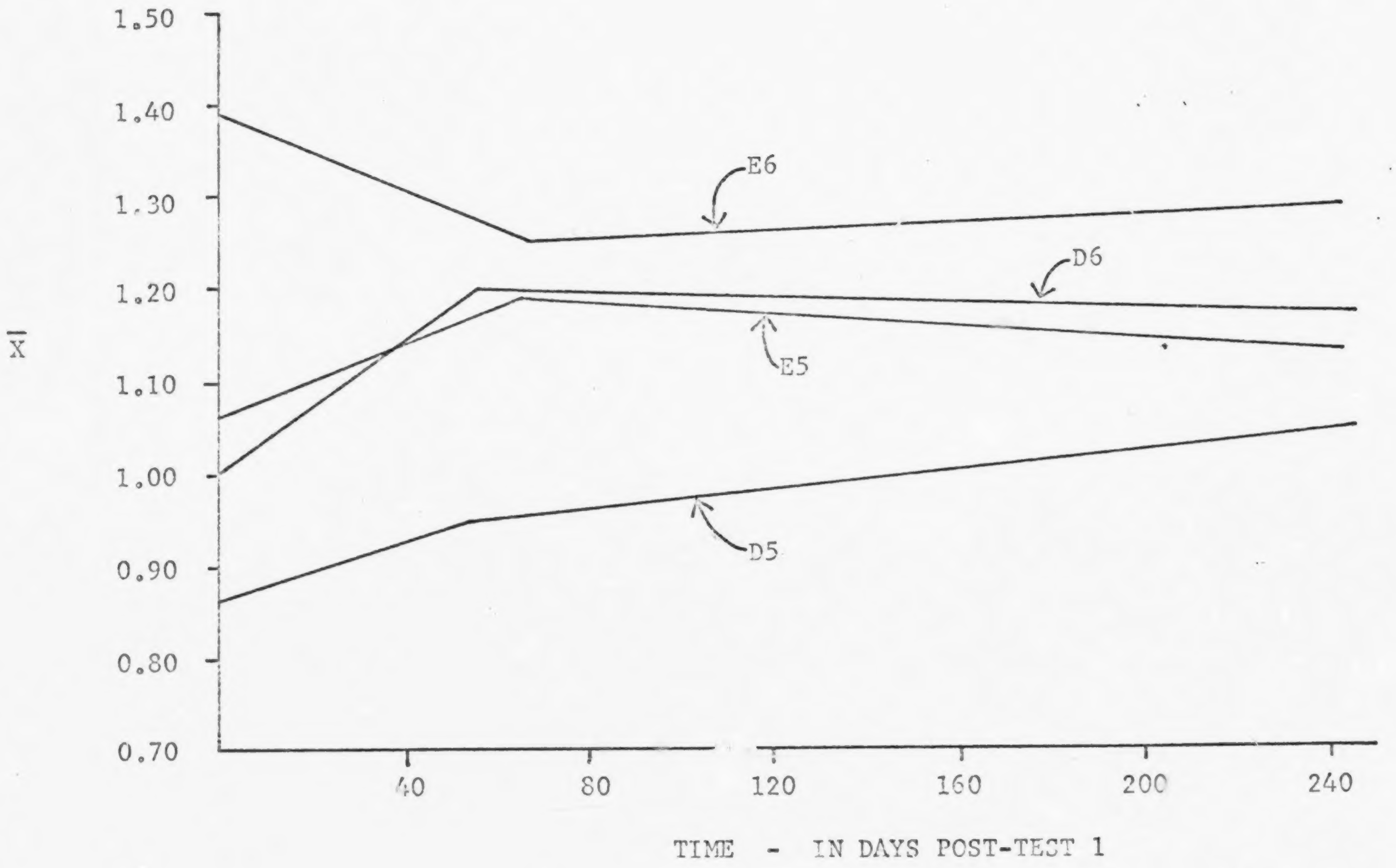


TABLE 7

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING THE FUNCTION OF SEED DISPERSAL MECHANISMS IN SELECTED PLANT FRUITS AND SEEDS

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}_1$	0.55	0.63	1.44	1.25
$\bar{X}_2$	0.62	0.89	1.92	2.03
$\bar{X}_5$	1.35	1.17	2.17	1.68
T_1	[illegible]	000	000	000
T_2	054	066	056	066
T_5	245	242	245	242
t_{1-2}	+0.370	+1.427	+2.698*	+2.853**
t_{2-5}	+1.535	+0.279	+0.346	-1.616

$\bar{X}_1$ = Mean of students' response scores to question 5, test 1.

$\bar{X}_2$ = Mean of students' response scores to question 5, test 2.

$\bar{X}_5$ = Mean of students' response scores to question 3, test 5.

T_1 = Time of test 1 in days post-test 1.

T_2 = Time of test 2 in days post-test 1.

T_5 = Time of test 5 in days post-test 1.

t_{1-2} = t score for Fisher's t test for differences between correlated means for means of test 1 and test 2 scores.

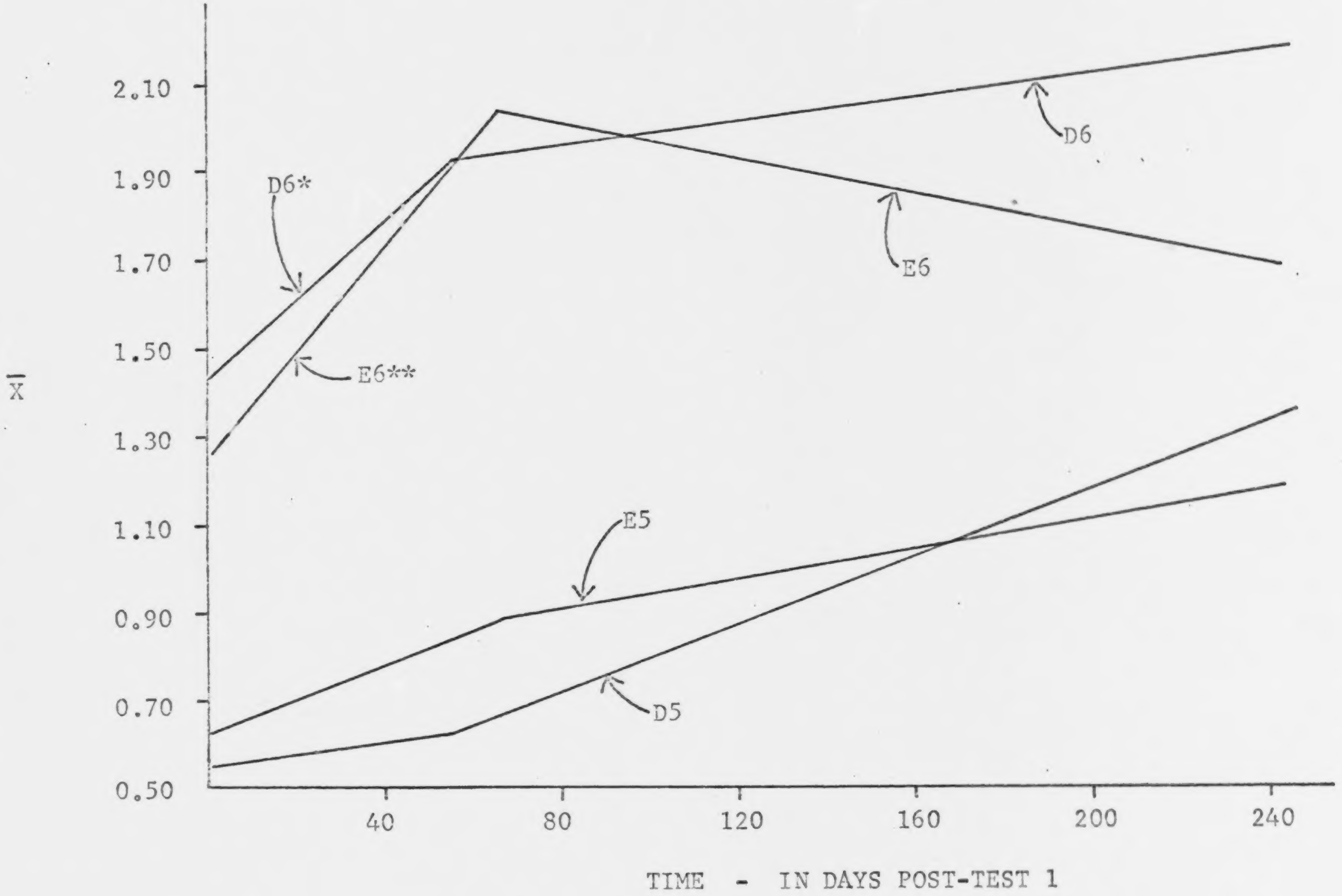
t_{2-5} = t score for Fisher's t test for differences between correlated means for means of test 2 and test 5 scores.

* The difference in means is significant at less than the .025 level.

** The difference in means is significant at less than the .005 level.

FIGURE 7

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING THE FUNCTION OF SEED DISPERSAL MECHANISMS IN SELECTED FRUITS AND SEEDS



Figures one through seven illustrate that the mean scores of most groups on all topics increased over time. The largest gains are shown to have occurred over the time of the autumn audio-taped instruction, the first fifty-five or sixty-six days, depending on the specific class, with the changes in subsequent mean scores either continuing to increase or decrease slightly over the remaining period. Post-autumn program instruction about these topics was for the most part incidental, involving at most a few minutes of audio-taped input over the remaining six months. For some topics there was no post-autumn lesson instruction. Considering the normal retention curves for rotely memorized information over time, the retention indicated by the data implies the occurence of a kind of learning that is far more durable than rotely memorized information.

A total of sixty-four changes in mean scores are represented on the first seven tables and figures for the four instructed classes. Forty-three of these changes are gains and twenty-one are either losses form the mean score of the previous test or indicate no change in mean score for a given group. Of the forty-three gains, three can be described as significant, there being a probability of less than 25/1000 of their having occurred by chance, and eight can be described as being very significant, having a probability of less than 5/1000 of occurring by chance. One significant decrease in mean score is shown on table three and illustrated in figure three. The relatively high frequency of "no response" to question five, test five of this group, coupled with their very significant increase in mean score between tests one and two, is most probably the cause of the significant loss which resulted from their responses to question five on test five.

Even though most changes in mean scores for these questions indicated increased knowledge, and but one loss was significant, the null hypothesis must stand for all but the twelve significant or very significant changes in mean scores.

Changes in students' responses occurring over short time spans

Tables and corresponding figures eight through fourteen concern instructed students' responses to seven questions that were repeated but one during the program. Again, the specific test questions are indicated on each of the tables and may be found in the appropriate tests in Appendix II. These questions pertained to perceptual skills such as the recognition of a coniferous woods and the identification of squirrel tracks in snow, and such information as knowledge of the specific winter resident wildlife that inhabit coniferous woodlands in Upstate New York, timing mechanisms in migratory birds, and general and specific springtime behaviors of various animals.

Of the twenty-eight mean score changes reported for the four instructed students' classes, twenty of the changes indicated gains in information, seven indicated losses, and one reflected no change in a mean score for one group. Five of the twenty-eight mean score changes were significant, and none were very significant. Three significant changes were gains and two losses. Five of the eight "no gain" changes reported in tables and figures eight through fourteen occurred within the same class of students. A perusal of the students' responses to tests four and five questions in Appendix II, will show a high to extremely high frequency of "no response" answers in this class to these questions. An explantion of the common failure of these students to answer some of the test five questions was supplied by their classroom teacher when the author picked up the test five student booklets. I was told that the students did not want to take any tests the day test five was administered in their classroom. It should also be noted that one of the three significant gains that occurred on the questions discussed here, was made by the same students.

Again, although twenty of the twenty-eight mean score changes recorded for these questions indicated increased knowledge, the null hypothesis must stand for all but the five instances of significant changes in mean scores. A more cursory analysis of the other repeated test questions, not reported here, indicated that general gains in information but rarely occurring significant gains were typical for the kinds of information assessed and the analysis procedures employed.

There are a variety of possible explanations for these findings. The findings may indeed indicate the true nature of the changes in cognition that occurred over the duration of the program. They may also indicate that the one hundred thirty-five minutes of audio-taped instruction, scattered out over more than two hundred forty days, was grossly insufficient to affect many significant changes in the instructed students cognitive development. The findings may indicate that the content of the audio-taped lessons and/or the presentation of the information was inappropriate to affect such changes. The evaluative tests employed may have been inappropriate to assess the kinds of changes sought.

Hibbard (1971, page 141) suggests this latter explanation in a discussion of his rationale for relying primarily on a Piagetian-revised clinical interview technique for assessing childrens' knowledge, after having used both interviews and written tests for such a purpose. He concluded that written tests may underestimate childrens' knowledge about conceptual information, and his data further indicate that written tests were least valid for assessing conceptual information of those students who were most knowledgeable about the specific information being assessed.

In this study, all students were grouped according to class and school membership. No attempt was made to categorize them as to the quantity or quality of their information. During the analysis, which required matching students initial scores with their own later scores for each repeated question, it was generally true that those students whose initial responses indicated greater initial knowledge, made greater individual gains. It seems probably that the evaluative tests employed and/or the methods of analysis were not adequate to fully assess changes in students' information.

TABLE 8

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING MIGRATORY BIRDS' PERCEPTION OF ENVIRONMENTAL CLUES TO THE APPROACH OF SPRING

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}_4$	1.85	2.52	3.08	3.36
$\bar{X}_5$	3.05	3.00	3.78	3.38
T_4	181	189	178	189
T_5	245	242	245	242
t_{4-5}	+2.105*	+1.041	+1.254	+0.466

$\bar{X}_4$ = Mean of students' response scores to question 2, test 4.

$\bar{X}_5$ = Mean of students' response scores to question 8, test 5.

T_4 = Time of test 4 in days post-test 1.

T_5 = Time of test 5 in days post-test 1.

t_{4-5} = t score for Fisher's t test for differences between correlated means for means of test 4 and test 5 scores.

* The difference in means is significant at less than the .025 level.

FIGURE 3

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING MIGRATORY BIRDS' PERCEPTION OF ENVIRONMENTAL CLUES TO THE APPROACH OF SPRING

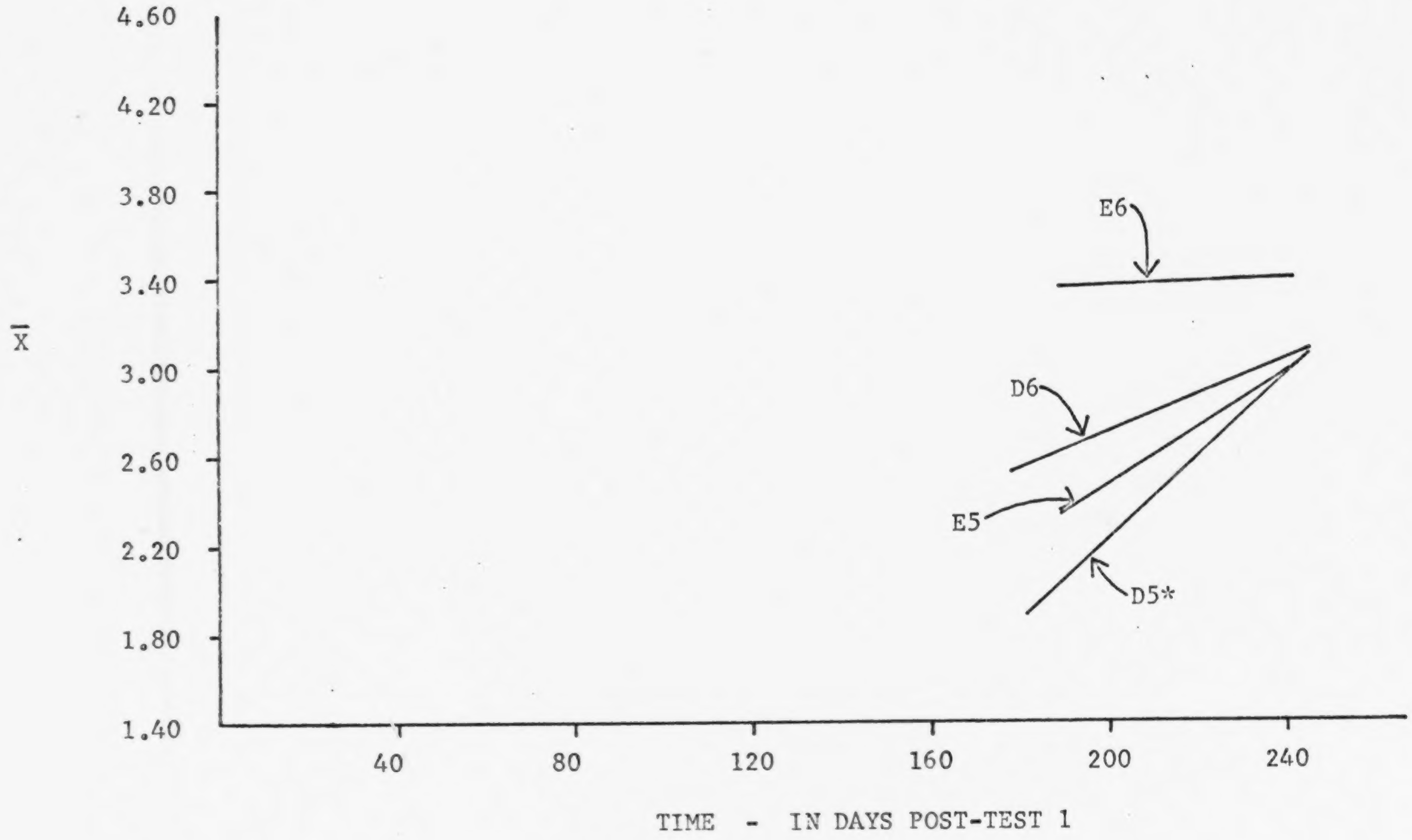


TABLE 9

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING THE RECOGNITION AND IDENTIFICATION OF A CONIFEROUS WOODS AS SHOWN IN A PROJECTED COLOR SLIDE

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}_3$	1.90	1.53	1.69	1.84
$\bar{X}_4$	1.55	1.76	1.87	1.80
T_3	082	084	082	084
T_4	181	189	178	189
t_{3-4}	-1.167	+1.237	+0.826	-0.272

$\bar{X}_3$ = Mean of students' response scores to question 8A, test 3.

$\bar{X}_4$ = Mean of students' response scores to question 8A, test 4.

T_3 = Time of test 3 in days post-test 1.

T_4 = Time of test 4 in days post-test 1.

t_{3-4} = t score for Fisher's t test for differences between correlated means for means of test 3 and 4 scores.

FIGURE 9

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING THE RECOGNITION AND IDENTIFICATION OF A CONIFEROUS WOODS AS SHOWN IN A PROJECTED COLOR SLIDE

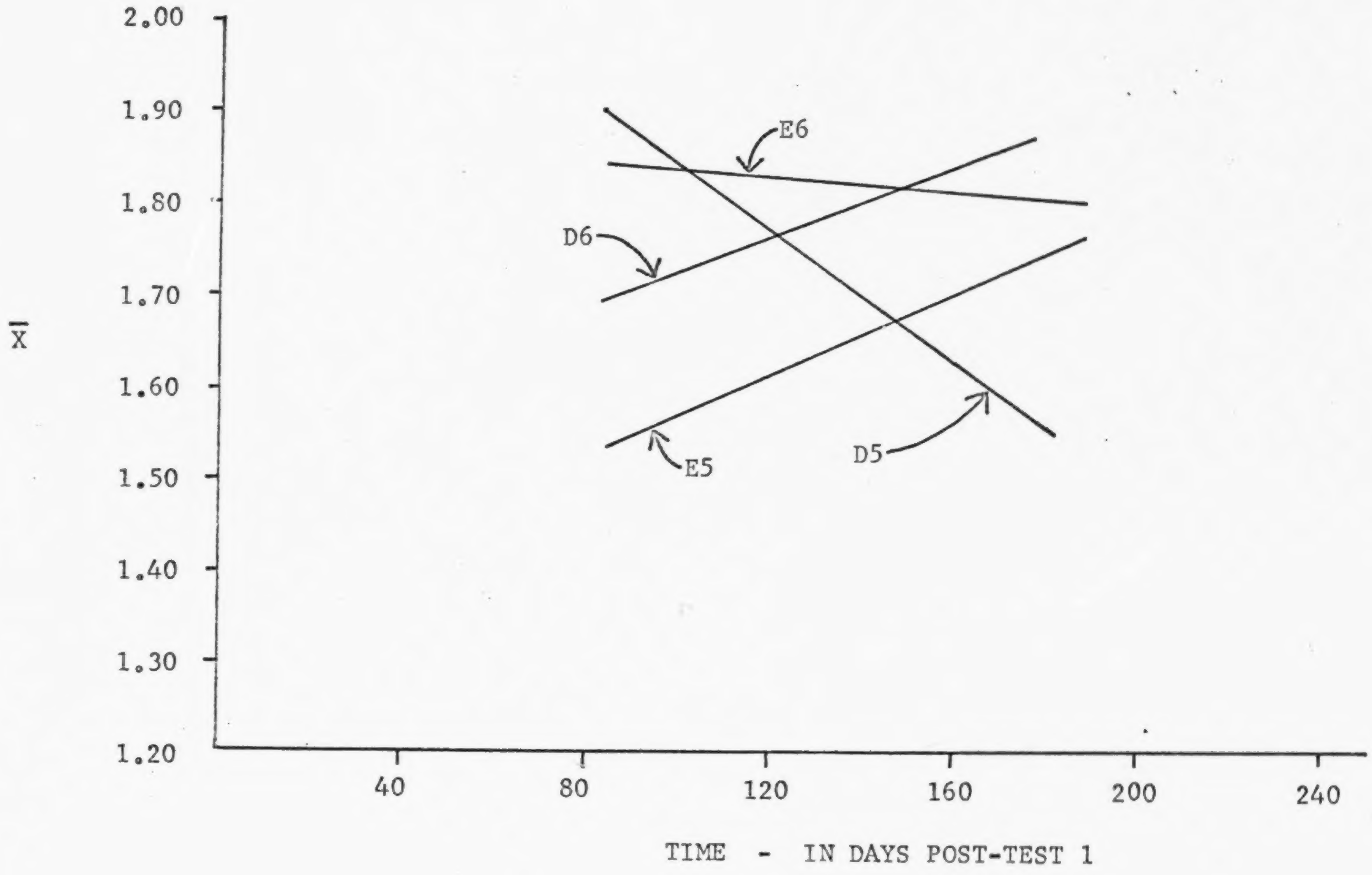


TABLE 10

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING THE KINDS OF WINTER RESIDENT WILDLIFE THAT INHABIT CONIFEROUS WOODLANDS

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}_3$	1.50	1.97	1.81	1.69
$\bar{X}_4$	1.65	2.10	2.30	2.48
T_3	082	084	082	084
T_4	181	189	178	189
t_{3-4}	+1.000	+1.114	+0.601	+2.030

$\bar{X}_3$ = Mean of students response scores to question 8B, test 3.

$\bar{X}_4$ = Mean of students response scores to question 8B, test 4.

T_3 = Time of test 3 in days post-test 1.

T_4 = Time of test 4 in days post-test 1.

t_{3-4} = t score for Fisher's t test for differences between correlated means for means of test 3 and test 4 scores.

FIGURE 10

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING THE KINDS OF WINTER RESIDENT WILDLIFE THAT INHABIT CONIFEROUS WOODLANDS

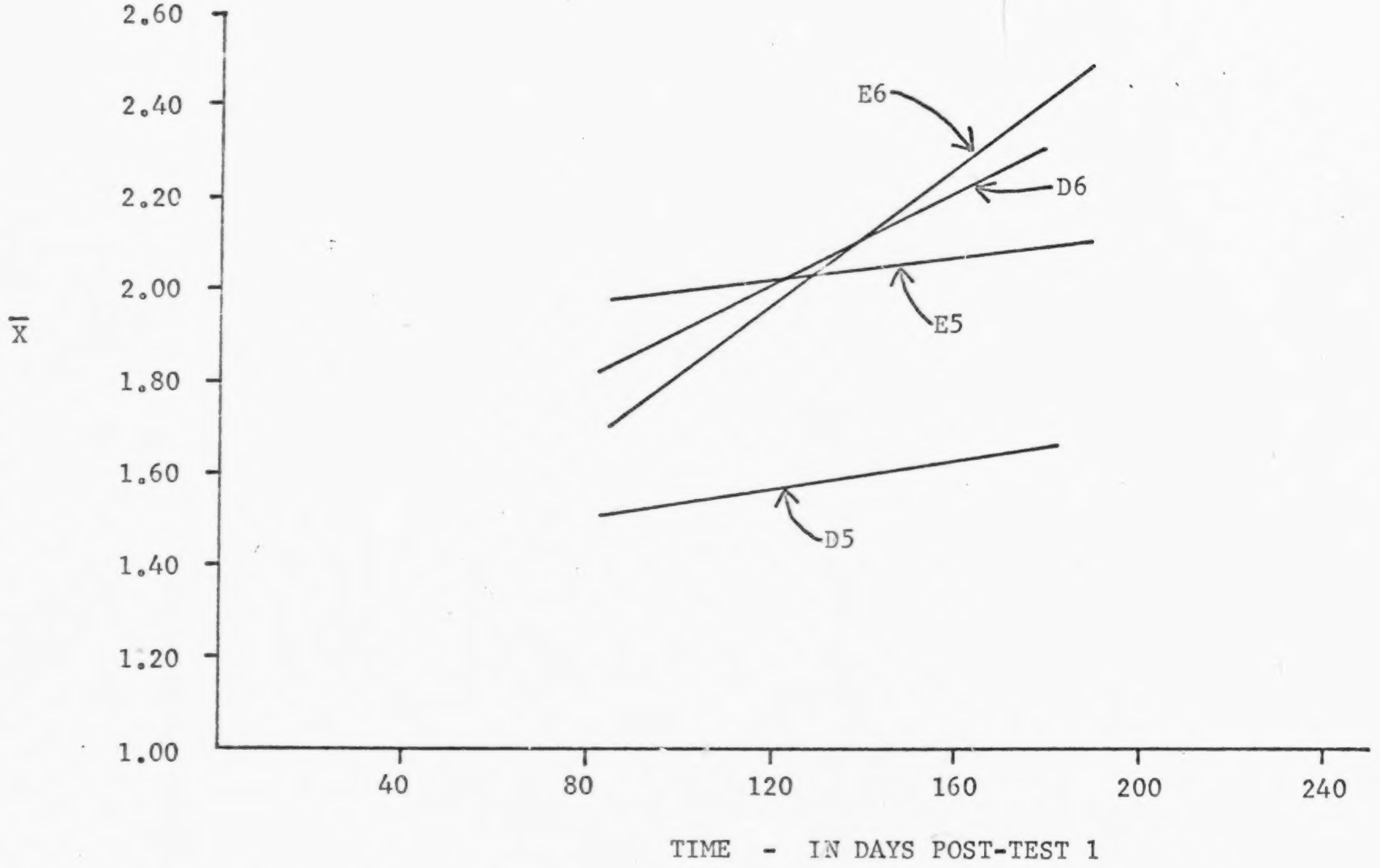


TABLE 11

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING THE IDENTIFICATION OF A SET OF GRAY SQUIRREL TRACKS IN SNOW AS SHOWN IN A PROJECTED COLOR SLIDE

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}_3$	2.60	1.85	2.12	1.88
$\bar{X}_4$	2.60	2.28	2.52	2.04
T_3	082	084	082	084
T_4	181	189	178	189
t_{3-4}	-0.270	+2.126*	+1.759	+1.446

$\bar{X}_3$ = Mean of students' response scores to question 11, test 3.

$\bar{X}_4$ = Mean of students' response scores to question 11, test 4.

T_3 = Time of test 3 in days post-test 1.

T_4 = Time of test 4 in days post-test 1.

t_{3-4} = t score for Fisher's t test for differences between correlated means for means of test 3 and test 4 scores.

* The difference in means is significant at less than the.025 level.

FIGURE 11

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING THE IDENTIFICATION OF A SET OF GRAY SQUIRREL TRACKS IN SNOW AS SHOWN IN A PROJECTED SLIDE

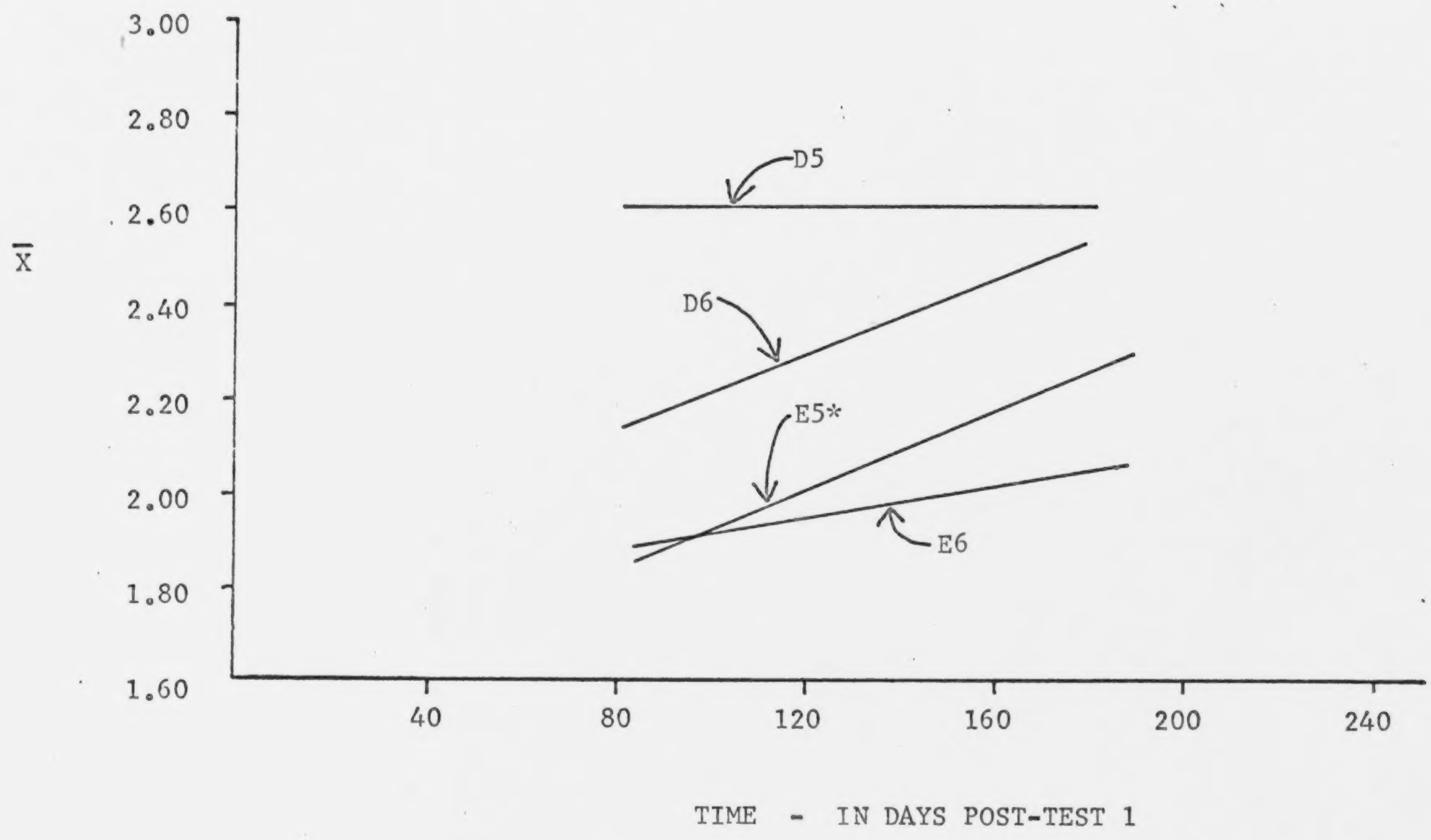


TABLE 12

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING COMMON SPRINGTIME ANIMAL ACTIVITIES AND BEHAVIOR

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}_4$	1.15	0.90	1.52	1.56
$\bar{X}_5$	0.70	1.16	1.65	1.29
T_4	181	189	178	189
T_5	245	242	245	242
t_{4-5}	-2.041	+0.862	+0.471	-1.478

$\bar{X}_4$ = Mean of students' response scores to question 1, test 4.

$\bar{X}_5$ = Mean of students' response scores to question 9, test 5.

T_4 = Time of test 4 in days post-test 1.

T_5 = Time of test 5 in days post-test 1.

t_{4-5} = t score for Fisher's t test for differences between correlated means for means of test 4 and test 5 scores.

FIGURE 12

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING COMMONLY OCCURING SPRINGTIME ANIMAL ACTIVITIES AND BEHAVIOR

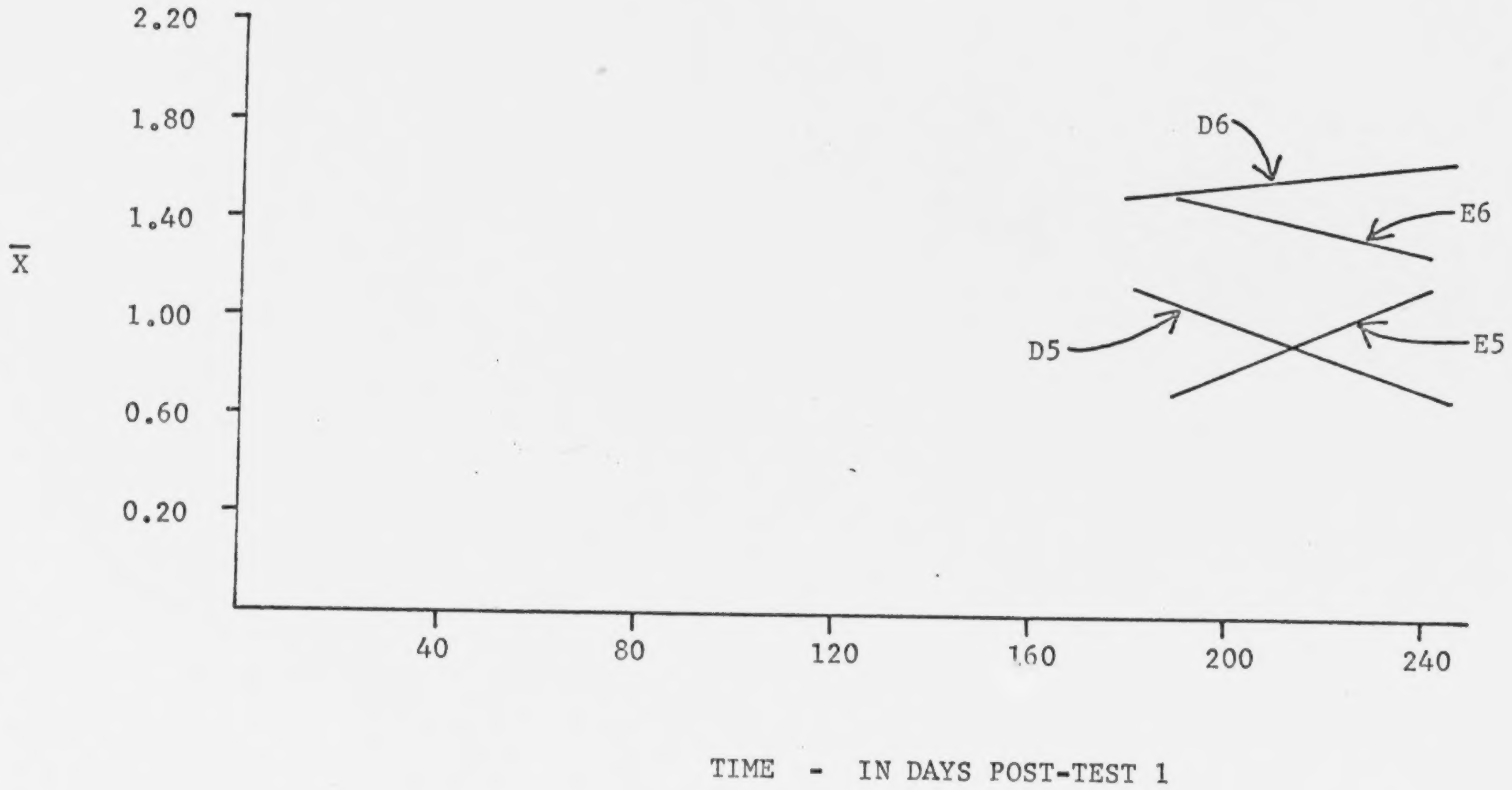


TABLE 13

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING THE PRIMARY CAUSE OF AMPHIBIAN SINGING DURING SPRING EVENINGS

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\overline{X}_4$	3.00	2.10	2.43	2.52
$\overline{X}_5$	1.95	2.66	3.00	2.64
T_4	181	189	178	189
T_5	245	242	245	242
t_{4-5}	-2.582*	+2.157*	+1.099	+0.692

$\overline{X}_4$ = Mean of students' response scores to question 6, test 4.

$\overline{X}_5$ = Mean of students' response scores to question 11, test 5.

T_4 = Time of test 4 in days post-test 1.

T_5 = Time of test 5 in days post-test 1.

t_{4-5} = t score for Fisher's t test for differences between correlated means for means of test 4 and test 5 scores.

* The difference in means is significant at less than the .025 level.

FIGURE 13

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING THE PRIMARY CAUSE OF THE SINGING OF SELECTED AMPHIBIANS DURING SPRING EVENINGS

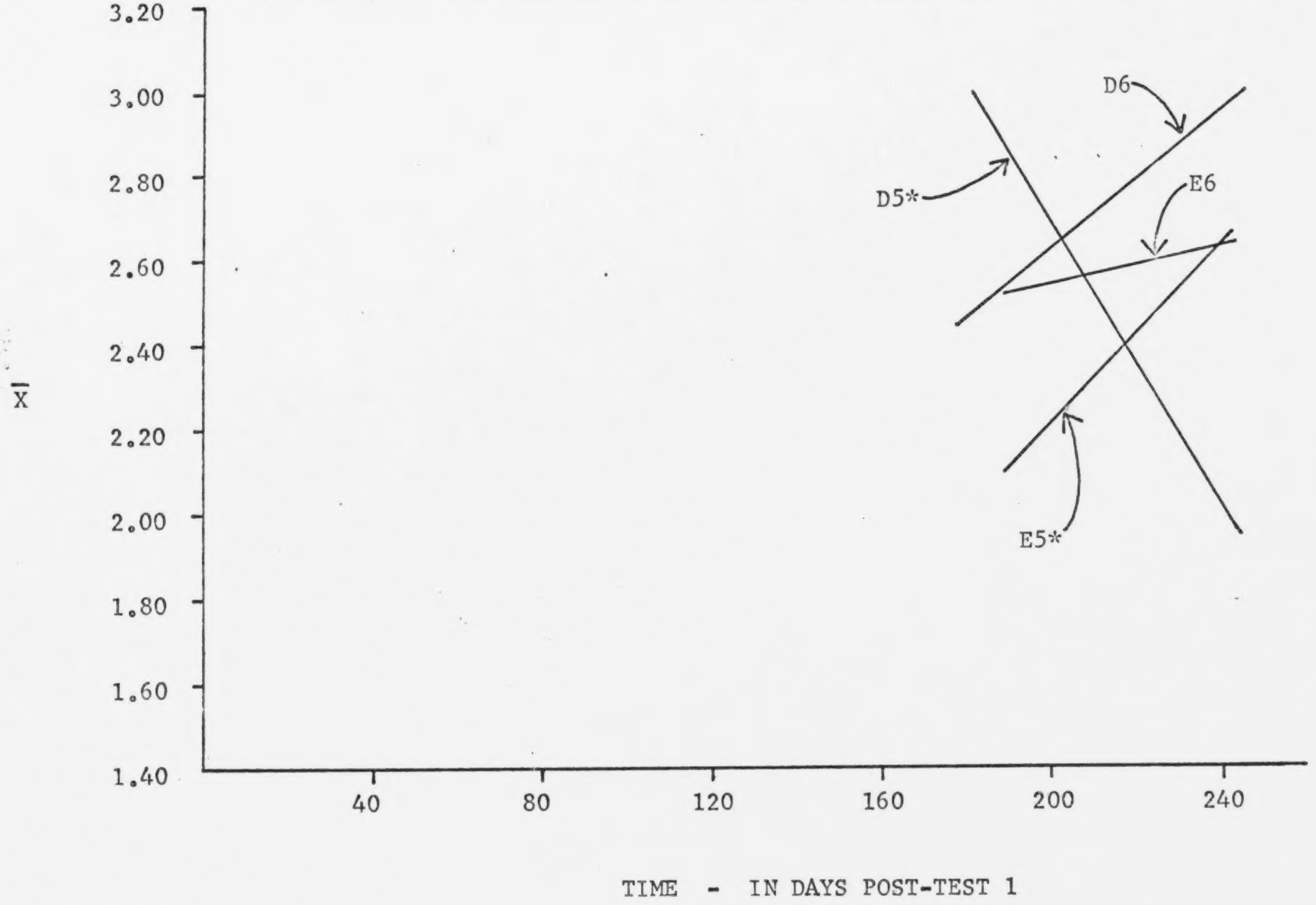


TABLE 14

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING THE REASONS DEER GIVE BIRTH TO FAWNS IN THE SPRING RATHER THAN DURING OTHER SEASONS OF THE YEAR

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}_4$	2.20	2.48	2.87	2.84
$\bar{X}_5$	1.50	2.53	2.30	3.11
T_4	181	189	178	189
T_5	245	242	245	242
t_{4-5}	-2.689*	+0.083	-1.943	+0.371

$\bar{X}_4$ = Mean of students' response scores to question 10, test 4.

$\bar{X}_5$ = Mean of students' response scores to question 10, test 5.

T_4 = Time of test 4 in days post-test 1.

T_5 = Time of test 5 in days post-test 1.

t_{4-5} = t score for Fisher's t test for differences between correlated means for means of test 4 and test 5 scores.

* The difference in means is significant at less than the .025 level.

FIGURE 14

MEAN SCORE CHANGES OF INSTRUCTED STUDENTS' RESPONSES TO A REPEATED TEST QUESTION CONCERNING THE REASONS DEER GIVE BIRTH TO FAWNS IN THE SPRING RATHER THAN DURING OTHER SEASONS

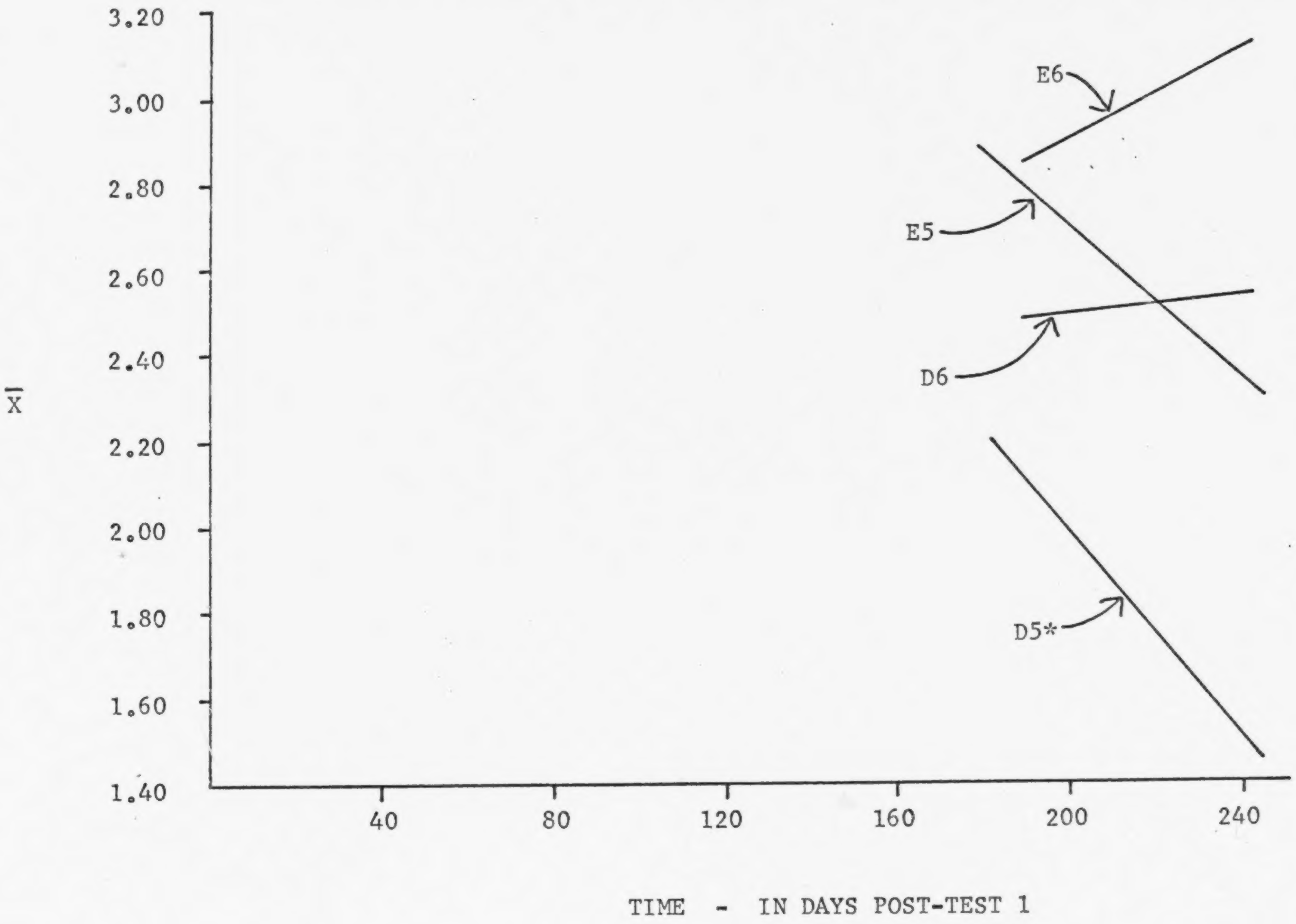
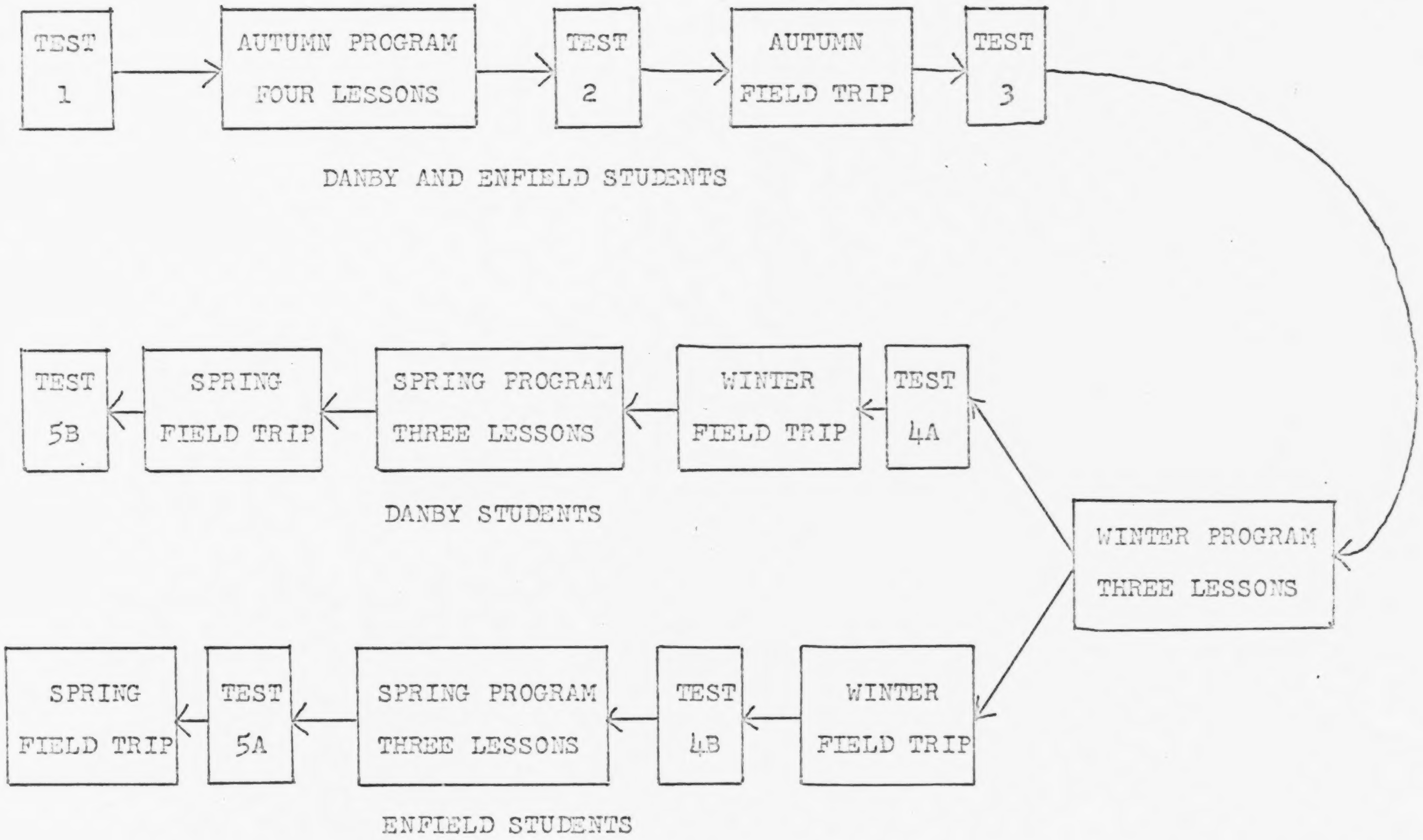


FIGURE 15

THE SEQUENCE OF PROGRAM EVENTS FOLLOWED BY INSTRUCTED STUDENTS


TEST 1
AUTUMN PROGRAM FOUR LESSONS
TEST 2
AUTUMN FIELD TRIP
TEST 3
DANBY AND ENFIELD STUDENTS
WINTER PROGRAM THREE LESSONS
TEST 4A
WINTER FIELD TRIP
SPRING PROGRAM THREE LESSONS
SPRING FIELD TRIP
TEST 5B
DANBY STUDENTS
WINTER FIELD TRIP
TEST 4B
SPRING PROGRAM THREE LESSONS
TEST 5A
SPRING FIELD TRIP
ENFIELD STUDENTS

Comparison of field trip experienced and non-experienced students' responses to the same test questions

To assist in evaluation of the usefulness of the program's field experiences, tests four and five were sequenced differently for the classes of the two instructed students' schools. Test four, when administered prior to students' attendance at winter field trips, was designated as test four-A and was so administered to all Danby School classes. The same test, designated as test four-B, was administered to the Enfield classes after attendance at winter field trips. Figure 15 illustrates the ordering of seasonal audio-taped lessons, seasonal field trips, and testing for both instructed schools.

The order of field trips and testing during the spring program was reversed for the two instructed schools. Enfield students attended test five-A given prior to their experiencing spring field trips.

The analysis of field trip-experienced and non-experienced students' responses to test four and five was performed with the aid of a Wang 360 electronic calculator. The analysis performed was a two-tailed Fischer's t test of the significance of differences in uncorrelated mean scores (Guilford, 1965, pages 181-186 and 580-531). The following formula applies to this analysis:

$$t = \frac{M_1 - M_2}{\sqrt{\left(\frac{\sum x_1^2 + \sum x_2^2}{N_1 + N_2 - 2}\right)\left(\frac{N_1 + N_2}{N_1 N_2}\right)}}$$

t = Fisher's t for differences between uncorrelated mean scores

M_1 = Mean of one group

M_2 = Mean of the other group

$\sum x_1^2$ = Sum of squares of the first group

$\sum x_2^2$ = Sum of squares of the second group

N_1 and N_2 = Number of cases in the two groups

The repeated test questions selected for comparison of pre-field trip and post-field trip responses analysis for both winter and spring field trip evaluations pertain to information that was either: (1) an important concern of the trips or (2) was of incidental or no concern, but involved objects and/or phenomena that would be readily observable to a trained observer in the area of the field trips. Three test four questions (winter) pertaining to life requirements in limited supply in the winter, evidence of wildlife having prepared in advance for spring, and the identification of squirrel tracks in snow, fit the first category above. The remaining four test four questions pertain to information that received incidental or no instruction on the winter field trips.

The data on table fifteen show that both the fifth and sixth graders who experienced winter field trips prior to taking test four performed better, but not significantly better than the test four-A (Danby) students on two of the three questions for which some field trip instruction was provided. Their mean scores for the squirrel track question were lower but not significantly so. The performance of the field trip experienced groups on the remaining four test four questions was also better, but not significantly better than that of the non-field trip experienced students of Enfield School.

The null hypothesis that there exists no significant nor very significant differences in mean scores of the winter field trip experienced and non-experienced groups must stand for all questions analysed.

Some significant differences in mean scores were observed in the comparison of experienced and non-experienced spring field trip groups. These differenced are shown for test five results on Table 16. The higher mean score of the Danby sixth grade students for question one about life requirement materials and conditions, and for the first part of question six, about the function of seeds, are significant at less than the .025 level. It should be noted that no explicit instruction, other than teaching techniques of stream and pond sampling and replies to students' queries about collected aquatic specimens were provided on the "discovery" spring field trips. All field trip instruction pertaining to the test five questions must be considered to be incidental or non-existant.

TABLE 15

COMPARISON OF INSTRUCTED STUDENTS' RESPONSES TO SELECTED PRE-WINTER FIELD TRIP TEST QUESTIONS (TEST 4-A) AND POST-WINTER FIELD TRIP TEST QUESTIONS (TEST 4-B)

	5th Grade Students		6th Grade Students	
	TEST 4-A	TEST 4-B	TEST 4-A	TEST 4-B
	Danby School	Enfield School	Danby School	Enfield School
QUESTION TWO - CHANGE IN DAYLENGTH IN BIRD PREPARATION FOR SPRING MIGRATION				
$\bar{X}$	1.85	2.52	3.08	3.36
S.D.	1.90	1.98	1.93	1.98
N	20	29	23	25
t	+1.1591		+0.4850	
d.f.	47		46	
QUESTION THREE - LIFE REQUIREMENT MATERIALS IN LIMITED SUPPLY IN WINTER				
$\bar{X}$	1.35	1.79	1.43	1.88
S.D.	0.96	0.96	0.77	0.91
N	20	29	23	25
t	+1.5444		+1.8026	
d.f.	47		46	
QUESTION FOUR - EVIDENCE OF WILDLIFE HAVING PREPARED IN ADVANCE FOR SPRING				
$\bar{X}$	0.45	0.83	0.87	0.96
S.D.	0.59	0.99	0.90	0.87
N	20	29	23	25
t	+1.5067		+0.3448	
d.f.	47		46	
QUESTION FIVE - CAUSE OF WEATHER BECOMING WARMER IN THE SPRING				
$\bar{X}$	2.25	2.41	2.82	3.24
S.D.	1.22	1.75	1.09	1.22
N	20	29	23	25
t	+0.7223		+1.2930	
d.f.	47		46	

TABLE 15 (Continued)

COMPARISON OF INSTRUCTED STUDENTS' RESPONSES TO SELECTED PRE-WINTER FIELD TRIP TEST QUESTIONS (TEST 4-A) AND POST-WINTER FIELD TRIP TEST QUESTIONS (TEST 4-B)

	5th Grade Students		6th Grade Students	
	TEST 4-A Danby School	TEST 4-B Enfield School	TEST 4-A Danby School	TEST 4-B Enfield School
QUESTION EIGHT - FIRST PART - ABILITY TO RECOGNIZE A CONIFEROUS WOODS				
$\overline{X}$	1.55	1.76	1.87	1.80
S.D.	0.80	0.67	0.74	0.80
N	20	29	23	25
t	+0.9748		-0.3073	
d.f.	47		46	
QUESTION EIGHT - SECOND PART - WINTER WILDLIFE INHABITANTS OF A CONIFER WOODS				
$\overline{X}$	1.65	2.10	2.30	2.48
S.D.	1.11	1.35	1.33	1.58
N	20	29	23	25
t	+1.2057		+0.4161	
d.f.	47		46	
QUESTION ELEVEN - IDENTIFICATION OF GRAY SQUIRREL TRACKS IN SNOW				
$\overline{X}$	2.60	2.28	2.52	2.04
S.D.	0.66	0.78	0.88	0.87
N	20	29	23	25
t	-1.4702		-1.8591	
d.f.	47		46	

TABLE 16

COMPARISON OF INSTRUCTED STUDENTS' RESPONSES TO
SELECTED PRE-SPRING FIELD TRIP TEST QUESTIONS (TEST 5-A) AND
POST-SPRING FIELD TRIP TEST QUESTIONS (TEST 5-B)

	5th Grade Students		6th Grade Students	
	TEST 5-A	TEST 5-B	TEST 5-A	TEST 5-B
	Enfield School	Danby School	Enfield School	Danby School
N	32	20	28	23
d.f.	50		49	
QUESTION ONE - LIFE REQUIREMENT MATERIALS AND CONDITIONS NECESSARY FOR LIFE				
$\bar{X}$	2.16	3.35	2.43	3.22
S.D.	0.97	1.46	1.27	1.14
t	+0.5526		+2.2683*	
QUESTION THREE - FUNCTION OF SEED DISPERSAL MECHANISMS ON SEEDS AND FRUITS				
$\bar{X}$	1.17	1.35	1.68	2.17
S.D.	1.12	1.19	1.19	1.17
t	+0.5397		+1.4451	
QUESTION FOUR - FIRST PART - TERMINAL AND AXIAL BUD POSITIONS				
$\bar{X}$	2.53	2.75	3.04	3.17
S.D.	1.68	1.61	1.38	1.46
t	+0.4577		+0.3196	
QUESTION FOUR - SECOND PART - TIME OF BUD DEVELOPMENT IN PERENNIAL PLANTS				
$\bar{X}$	1.28	1.60	1.50	1.78
S.D.	0.72	0.92	0.82	0.93
t	+1.3712		+1.1193	
QUESTION SIX - FIRST PART - THE FUNCTION OF SEEDS IN PLANT REPRODUCTION				
$\bar{X}$	1.75	1.80	1.71	2.00
S.D.	0.56	0.60	0.59	0.00
t	+0.2988		+2.3106*	

* The difference in group means (correlated) is significant at less than the .025 level.

TABLE 16 (Continued)

COMPARISON OF INSTRUCTED STUDENTS' RESPONSES TO
SELECTED PRE-SPRING FIELD TRIP TEST QUESTIONS (TEST 5-A) AND
POST-SPRING FIELD TRIP TEST QUESTIONS (TEST 5-B)

	5th Grade Students		6th Grade Students	
	TEST 5-A Enfield School	TEST 5-B Danby School	TEST 5-A Enfield School	TEST 5-B Danby School
N	32	20	28	23
d.f.	50		49	
QUESTION SIX - SECOND PART - FLOWERS AND/OR CONES FUNCTION IN SEED DEVELOPMENT				
$\overline{X}$	1.13	1.05	1.29	1.17
S.D.	0.54	0.59	0.59	0.64
t	-0.4917		-0.6818	
QUESTION SEVEN - SECOND PART - SUMMER SUN POSITION AS SEEN FROM EARTH				
$\overline{X}$	2.81	2.85	2.71	2.57
S.D.	1.07	1.31	1.28	1.14
t	+0.1178		-0.4001	
QUESTION EIGHT - CHANGE IN DAYLENGTH IN BIRD PREPARATION FOR SPRING MIGRATION				
$\overline{X}$	3.00	3.05	3.38	3.78
S.D.	2.00	2.25	1.74	1.98
t	+0.0819		+0.7523	
QUESTION NINE - SPRINGTIME BEHAVIOR OF ANIMALS				
$\overline{X}$	1.16	0.70	1.29	1.65
S.D.	1.12	0.95	1.44	1.27
t	-1.4959		+0.9180	
QUESTION ELEVEN - FUNCTION OF THE SINGING OF TOADS IN THE SPRING				
$\overline{X}$	2.66	1.95	2.64	3.00
S.D.	1.47	1.56	1.49	1.35
t	-1.6236		+0.8776	

Test five-B administrated to Danby students was likewise performed prior to any possible post-field trip classroom or science instruction about the aquatic specimens the students carried back to their classrooms and homes.

Better performance by either/or the Danby fifth and sixth grade students was observed on seven of the eight remaining test five questions. Both the Enfield fifth and sixth graders performed better on the question about the role of flowers and/or cones in seed development.

The null hypothesis that there exists no significant nor very significant differences in mean scores between the spring field trip experienced and non-experienced groups must stand for all the test five questions except the two questions previously discussed.

The role of field experiences in environmental education programs has been assumed by most environmental educators to be a vital role. Most environmental educators feel that outdoor experiences can provide both basic instruction and reinforcement of earlier instruction, because of the "observable" materials and phenomena that occur outdoors. The author, at the beginning of this thesis, assumed only that such experiences could serve in a reinforcing capacity. He has seldom had the experience of observing untrained people, of any age, derive much information from the so called "observable" phenomena of natural environments. The scarcity of significant differences in performance of field trip experienced students indicated by the data here, suggests that both assumptions as to the role of field experience warrant closer appraisal. It is possible that field experiences in environmental education efforts can best play a role in affecting desired attitudinal changes in people. This is a question to which this study was not addressed. I think that some caution is needed in this assumption too. What constitutes "observable" phenomena in nature is highly a function of the perception of the observer. What events influence attitudinal changes in people is probably likewise a function of the individual.

Intraschool comparison of variations in sixth grade students' pre-program and fifth grade students' post-program test performances

No discussion has as yet been offered as to attempts to compare learning outcomes of fifth grade students and sixth grade students, or learning outcomes of instructed students and non-instructed students. The following discussion and data analysis is concerned with these questions.

The data observable on tables one through sixteen and on figures one through fourteen indicate that although instructed fifth graders generally performed below levels attained by instructed sixth graders, both age groups also commonly increased in performance throughout the instructional program. It should be noted that the fifth grade students achieved slightly more (nine) significant or very significant gains than did the sixth grade students (seven). From the author's experience, he believes that differences in fifth and sixth graders' abilities and interests in learning the kinds of information found in the content of this instructional program are small. The additional year of life of sixth grade students is of some consequence in preparing them to assimilate and order information. Their additional maturity is also in evidence in their cognitive abilities when they assume the role of sixth graders at the beginning of the school year. This will become more apparent in the following discussion.

An attempt was made to ascertain the significance of differences in performance between both instructed and non-instructed sixth grade students prior to program implementation and their fifth grade counterparts after completion of the instructional program, or for the non-instructed children, completion of most of the school year, on an intraschool basis. Two questions motivated this analysis. One questions asks what if any differences exist between instructed and non-instructed students, and the second question asks whether fifth grade students attained test performance levels of their sixth grade counterparts by the end of the instructional program in the spring.

The author used the Wang 360 electronic calculator and a two-tailed Fisher's t test for significant differences in uncorrelated mean scores to answer these questions (Guilford, 1965, pages 181-186 and 580-581). The data were derived from all students' responses to all questions common to test one (the pre-instruction test) and test five (the post-instruction test), and is tablulated in Table 17. Shown on this table are summations of the content of each question, group sizes (N), degrees of freedom (d.f.), group's mean scores (X), standard deviations (S.D.), and the t scores obtained from the original data. It should be noted that because of the haphazard constituency of the non-instructed students and the total inability to realistically assess their instructional input, each point having been discussed earlier, the reasons for any differences between instructed and non-instructed students' performances can at best only be implied.

The observed differences between instructed and non-instructed students are differences of both kind and degree of performance. The non-instructed fifth grade students of Northeast School failed, in June, 1971, to achieve the performance levels observed in the autumn of 1970 for their sixth grade counterparts on nine of the eleven questions. (82 per cent of the questions) The instructed fifth graders also generally failed to achieve the earlier performance levels of their sixth grade counterparts, but so failed in only 59 per cent of the same questions. Significant failures of the non-instructed fifth graders were found in 33 per cent of the questions and significant failures of the instructed students occurred in 15 per cent of the questions.

In answer to the first question comparing the instructed and non-instructed students' test performances, the data indicate that more non-instructed fifth graders failed to attain pre-program sixth grade performance levels than did instructed fifth graders, and further that more of the non-instructed fifth grade students' failures were significant. The data, even being of a negative nature, may imply that attendance of the instructional program resulted in better performance of instructed fifth grade students than non-instructed fifth grade students.

TABLE 17

COMPARISON OF MEAN SCORES OF SIXTH GRADE STUDENTS' RESPONSES TO SELECTED PRE-PROGRAM TEST QUESTIONS (TEST 1) AND FIFTH GRADE STUDENTS' RESPONSES TO POST-PROGRAM TEST QUESTIONS (TESTS 5-A AND 5-B)

	Danby School		Enfield School		Northeast School	
	Fifth Grade	Sixth Grade	Fifth Grade	Sixth Grade	Fifth Grade	Sixth Grade
CLASS SIZE (N) AND DEGREES OF FREEDOM (d.f.) FOR ALL QUESTIONS						
N	20	27	32	31	24	14
d.f.	45		61		36	
LIFE REQUIREMENT MATERIALS AND CONDITIONS (Test 1-1 and Test 5-1)						
$\overline{X}$	2.35	2.41	2.16	2.22	2.71	3.38
S.D.	1.46	1.37	0.97	1.50	0.89	1.04
t	-0.1423		+0.1861		-2.0450*	
CAUSE OF SEASONAL VARIATION IN TEMPERATURE (Test 1-4 and Test 5-2)						
$\overline{X}$	2.15	2.11	2.25	2.48	2.96	3.00
S.D.	1.82	1.13	1.52	1.29	1.24	1.93
t	+0.0906		-0.6362		-0.0756	
FUNCTION OF SEED DISPERSAL MECHANISMS (Test 1-5 and Test 5-3)						
$\overline{X}$	1.35	1.44	1.17	1.25	1.00	2.14
S.D.	1.19	1.23	1.12	1.26	1.15	1.69
t	-0.2460		-0.2623		-2.4020*	
TERMINAL AND AXILLARY BUDS ON WOODY PLANTS (Test 1-7A and Test 5-4A)						
$\overline{X}$	2.75	2.07	2.53	2.12	2.00	0.86
S.D.	1.61	1.59	1.68	1.81	1.89	1.64
t	+1.4110		+0.9173		+1.8311	

* The difference in group means (uncorrelated) is significant at less than the .025 level.

TABLE 17 (Continued)

COMPARISON OF MEAN SCORES OF SIXTH GRADE STUDENTS' RESPONSES TO SELECTED PRE-PROGRAM TEST QUESTIONS (TEST 1) AND FIFTH GRADE STUDENTS' RESPONSES TO POST-PROGRAM TEST QUESTIONS (TESTS 5-A AND 5-B)

	Danby School		Enfield School		Northeast School	
	Fifth Grade	Sixth Grade	Fifth Grade	Sixth Grade	Fifth Grade	Sixth Grade
CLASS SIZE (N) AND DEGREES OF FREEDOM (d.f.) FOR ALL QUESTIONS						
N	20	27	32	31	24	14
d.f.	45		61		36	
TIME OF BUD DEVELOPMENT IN PERENNIAL PLANTS (Test 1-7B and Test 5-4B)						
$\bar{X}$	1.60	2.44	1.28	1.84	1.25	1.38
S.D.	0.92	0.87	0.72	0.98	0.66	0.72
t	-3.1250**		-2.5489*		-0.5511	
ENVIRONMENTAL CLUES TO THE APPROACH OF WINTER (Test 1-8 and Test 5-5)						
$\bar{X}$	2.85	3.15	3.22	3.42	3.54	3.50
S.D.	1.96	1.69	1.83	1.72	1.68	1.84
t	-0.5498		-0.4395		+0.0665	
FUNCTION OF SEEDS IN PLANT REPRODUCTION (Test 1-9A and Test 5-6A)						
$\bar{X}$	1.80	1.78	1.75	1.94	1.83	2.00
S.D.	0.60	0.57	0.56	0.24	0.47	0.00
t	+0.1138		-1.7130		-1.3170	
SEED DEVELOPMENT IN FLOWERS AND/OR CONES (Test 1-9B and Test 5-6B)						
$\bar{X}$	1.05	1.00	1.13	1.39	1.17	1.50
S.D.	0.59	0.47	0.54	0.55	0.47	0.50
t	+0.3162		-1.8630		-1.9850	

* The difference in group means (uncorrelated) is significant at less than the .025 level.

** The difference is significant at less than the .005 level.

TABLE 17 (Continued)

COMPARISON OF MEAN SCORES OF SIXTH GRADE STUDENTS' RESPONSES TO SELECTED PRE-PROGRAM TEST QUESTIONS (TEST 1) AND FIFTH GRADE STUDENTS' RESPONSES TO POST-PROGRAM TEST QUESTIONS (TESTS 5-A AND 5-B)

	Danby School		Enfield School		Northeast School	
	Fifth Grade	Sixth Grade	Fifth Grade	Sixth Grade	Fifth Grade	Sixth Grade
CLASS SIZE (N) AND DEGREES OF FREEDOM (d.f.) FOR ALL QUESTIONS						
N	20	27	32	31	24	14
d.f.	45		61		36	
WINTER SUN POSITION AS SEEN FROM EARTH (Test 1-10A and Test 5-7A)						
$\overline{X}$	2.25	2.07	2.44	3.00	2.25	3.21
S.D.	1.37	1.33	1.52	1.27	1.41	1.26
t	+0.4432		-1.5590		-2.0480*	
SUMMER SUN POSITION AS SEEN FROM EARTH (Test 1-10B and Test 5-7B)						
$\overline{X}$	2.85	2.67	2.81	2.77	2.88	3.29
S.D.	1.31	1.15	1.07	1.15	1.27	1.22
t	+0.4891		+0.1407		-0.9479	
CAUSE OF LEAF LOSS BY DECIDUOUS PLANTS IN AUTUMN (Test 1-12 and Test 5-12)						
$\overline{X}$	1.45	1.89	2.50	2.58	2.88	3.00
S.D.	1.32	1.42	1.62	1.19	1.39	1.25
t	-1.0590		-0.2192		-0.2592	

* The difference in group means (uncorrelated) is significant at less than the .025 level.

In reply to the second question, concerning post-program cognitive competencies of instructed fifth grade students relative to their sixth grade counterparts, the data raise serious questions as to the effects of the instructional program in bringing fifth graders' cognitive abilities up to the level of their sixth grade counterparts three months hence in the autumn. it is clear that the sixth grade students not only began the program more knowledgeable than did the fifth grade students, but that they remained more knowledgeable at the end of the instructional program, as to the questions asked on the evaluative tests. Even when consideration is given to the greater number of significant cognitive gains made by the instructed fifth grade students during the testing program, the fifth graders were generally not at the levels of understanding of their sixth counterparts at the end of the program. I am, and have been, discussing group's mean scores throughout this chapter. Numerous examples of individual fifth graders more knowledgeable than individual sixth graders occurred throughout the testing. It does appear, however, that maturation of the children during the two and one half or three months of summer between their fifth and sixth grade school years may have a relatively high influence on their ability to respons favorably to the kinds of questions asked on tests one and five.

CHAPTER VI

SUMMARY AND CONCLUSIONS

In this study, the author designed, developed, revised, implemented, and evaluated a one year environmental education program for fifth and sixth grade students. The program consisted of ten structured and sequential audio-taped individually attended instructional lessons and three post seasonal lesson program outdoor field trips in areas adjacent to the instructed students' schools. The audio-taped lessons, comprising three seasonal prefield trips in areas adjacent to the instructed students' schools. The audio-taped lessons, comprising three seasonal prefield trip programs, were of about twenty-seven minutes duration each, and were designed to teach conceptual, factual, and interpretative skill information of an ecological and conservation nature. The implementation of the instructional lessons and the post seasonal program field trips involved many people. Most instrumental in assisting program implementation were seventeen teachers and four administrators of the staffs of two experimental schools and one control school.

Students participating in the program consisted of one hundred thirty-eight instructed upper elementary school students from two rural schools of the Ithaca School District of Ithaca, New York, and ninety-eight non-instructed upper elementary school students from a suburban school of the same school district. Of the two hundred thirty-six students, one hundred twenty-nine were fifth grade children and one hundred seven were sixth grade children. A number of other children ranging in age from lower elementary school aged children to high school aged children were involved as experimental participants in the early stages of lesson structure and content design, and in the development and revision of a supplementary teaching game.

During the duration of the study the author was provided office space, program development space, and the use of a wide variety of program development and replication apparatus by the Division of Science and Environmental Education of the New York State College of Agriculture at Cornell University, Ithaca, New York. Most of the funding for the design, developement, and evaluation of this study was provided by a U. S. Office of Education Small Research Grant Number OEG 2-700025(509), Project Number 9B123. The author was employed as a staff member of the Tompkins-Seneca-Tioga Board of Cooperative Educational Services at Ithaca, New York, during the duration of this study. This group constituted the Local Contracting Agency for the U.S. Office of Education research project.

From such assessment devices and techniques as five evaluative student tests, a school staff questionnaire, numerous hours of observation of students attending the audio-taped lessons and the post-program field trips, and additional hours of communication with involved staff members of the participating schools, the author arrived at the following conclusions. Both the conclusions and the development of the instructional materials of this study may be regarded as empirical.

1. Some learning gains in instructed students' acquisition of ecological and conservation conceptual and factual information and interpretative skills, some of which must be attributed to the program were made during the time-span of this study, but the evaluative procedures and devices employed were not sufficiently sensitive to detect small changes in students' knowledge and skills.

2. Primary learning gains may be due to maturation of the students, and the real or apparent failure of instructional lesson input to affect large gains is most probably due to inadequacies in lesson content design and/or failure to sufficiently assess student knowledge both prior to and following instructional input.

3. The type and quality of the instructional input was probably comparable to that found in the few existing school environmental education programs, but by intent deviated from most school environmental education program objectives, instructional modes, and evaluation goals.

4. The study showed that a person extensively trained in the natural sciences, conservation education, and ecological sciences, and experienced in teaching both in classrooms and outdoors at a range of age levels from elementary school children to adults, cannot easily design instructional materials that affect well defined changes in cognition when due consideration is not given to substantial revision of instructional input based on students' performances. The author further concludes that less knowledgeable and less experienced conclaves of teachers can hardly be expected to design and develop environmental education instruction that can affect major cognitive changes in students, without the expert guidance of learning theorists and learning evaluators.

5. The findings strongly imply that participation of all involved school personnel in an advisory capacity during the earliest formative stages of environmental education programs, and in implementation capacities during later stages of any such program, is imperative.

6. The findings indicate that the individually attended audio-taped lessons employed in this study can readily be implemented in schools by school personnel, and can be employed at costs that are not excessive to most schools and substantially lower than current operating expenses required by most existing environmental education efforts.

7. The findings also indicate that the audio-taped mode of instruction may, with adequate support of school personnel, provide not only an efficient mode of instruction, but provide the basis for an effective instructional program for teaching selected ecological and conservation concepts and facts, and environmental interpretation skills.

I believe that the findings of this study provide a number of implications for further study and further environmental education program development. Some of the implications are included in the following recommendations. It is recommended that:

1. Objective assessment of would-be learners knowledge and experiences using some existing evaluation procedures, but relying primarily on new and empirically devised assessment techniques, be undertaken to define specific and detailed information about their conceptual frameworks, factual knowledge, environmental interpretation experiences and skills, conservation attitudes, and past behavior in environmental matters.

2. Such information obtained by these efforts be used to revise the content and structure of these existing instructional materials where necessary, and to design and develop new instructional materials having both the selection and sequencing of the content of the instructional input based on such empirically derived information.

3. Long-term investigations be conducted with the active participation of the would-be learners, their teachers and administrators, and all local, educational, and governmental personnel willing to assume a role in such efforts.

The major point of this thesis is that the development of instruction designed to affect gross changes in student cognition about ecological and conservation information -- which the author believes are requisite to any and all critical thinking, attitude development, and behavioral changes in environmental matters -- not only requires a considerable expenditure of time and effort, but must be empirical and must involve extensive testing and revision, before one can have any certainty of the effectiveness of such instruction.

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APPENDIX I

INSTRUCTIONAL MATERIALS

LESSON HARDWARE

The hardware components of each lesson are the same. A set of one each of the following four hardware items remains in the classroom or learning center lesson carrel for use with the various lessons throughout a program period.

1. Tape recorder-player. Cassette type recorder-player. Panasonic brand, Model RQ-209S, the "Allendale".

2. Slide Magnifier-Viewer. This is a hand held and/or table resting slide viewer that has a one slide capacity. PANA-VUE brand, Model Electric R, with a GAF brand transformer plug and remote cord. Magnification is 4X.

3. Slide Holding Tray. Thirty-six or forty slide capacity, plastic slide holding trays of a type normally used with color slide viewers. Slides are held individually in slots, in an upright position. A variety of brands of slide trays are used.

4. Ear Phone Head Set. TELEX-ACOUSTICS brand, Model 610-1, with a five foot remote cord.

LESSON SOFTWARE.

AUTUMN LESSON NUMBER ONE, SOFTWARE.

1. Bulletin Board, portable, 23½"x19¼"x¼", containing the following color photographs and black print on white signs (xerox copies): in the positions indicated in parentheses:
   a. Lesson label, 1¼x2", with the inscription, "ENVIRONMENTAL EDUCATION - FALL PROGRAM - LESSON ONE." (Top, left corner).

   b. Instruction sign, 9"x3¼" with the inscription, "TO BEGIN, PLEASE PUT ON THE EAR PHONES, AND THEN PUSH DOWN BUTTON NUMBER ONE ON THE TAPE RECORDER." (Upper, center).

   c. Color photograph, 5"x7", of a fifth grade student collecting aquatic life while on an autumn field trip. (Center, left side).

   d. Color photograph, 5"x7" of three elementary school children looking at a trail marking sign while on an autumn hike. (Center, right side).

   e. Color photograph, 8"x8", of autumn leaf colors of Sugar Maple and Northern Red Oak trees. (Bottom, center).

   f. Sign, 6"x3¼", entitled "LIVING THINGS", and listing the following; "ANIMALS, PLANTS, MICROORGANISMS, PEOPLE." (Bottom, left side).

   g. Sign, 6"x3½", entitled "LIVING THINGS NEED", and listing the following: "WATER, AIR, TEMPERATURE RANGE, CHEMICAL ELEMENTS, SPACE, ENERGY." (Bottom, right side).

2. Earth Model, made from a ping-pong ball, and mounted on a brass rod axis on a black wooden base. There is a line made from twenty-four equidistantly spaced India ink black dots, drawn at a forty-second north parallel, with the following inscription, "You Live Somewhere On This Line", and the words, "MATERIALS, RULES, CONDITIONS", written in India ink on the equator.

3. Color Slides, Kodachrome and Ektachrome, 2"x2", (35mm and 28mm x 28mm), nine in number, each enclosed in a 2"x2" KIMAC brand plastic slide protector, and labeled by means of a self-adhesive plastic label-maker numbers, with consecutive numbers from one through nine. A brief description of each of the color slides follows: (photograph by the author unless otherwise indicated)

    a. Slide 1. Two girls inspecting a tidal pool with the Atlantic Ocean in the background.

    b. Slide 2. A scene taken in the Rocky Mountains at tree line, showing bush-like and deformed Subalpine Spruce in the foreground.

    c. Slide 3. A Palm Tree (Professor Richard B. Fischer)

    d. Slide 4. A close-up of a human hand holding soil. (R.B. Fischer)

    e. Slide 5. A picture of closely spaced trees, just below the canopy level, taken in an eastern deciduous woodlot.

    f. Slide 6. A close-up of a bullfrog in a clear fresh water pond.

    g. Slide 7. A close-up of a one-half gallon milk carton and an orange juice can, each containing soil and young oak tree seedlings.

    h. Slide 8. A cat, shown eating cat food from a cat food can.

    i. Slide 9. A close-up of poison ivy plants.

4. Audio-taped Lesson. Twenty-five minute audio lesson on Norelco brand, Model C-60 tape cassette. The script for Autumn Lesson One can be found in the Appendix under the heading of "Lesson Scripts."

AUTUMN LESSON NUMBER TWO, SOFTWARE.

1. Bulletin Board, portable, 23½"x19¼"x¼", containing the following black print on white signs, pictoral diagrams, and charts (hand-colored, xerox copies), in the positions indicated in parentheses following brief descriptions of each of the bulletin board materials.

    a. Lesson Label, 1¼"x2", with the inscription, "ENVIRONMENTAL EDUCATION - FALL PROGRAM - LESSON TWO." (Top, left corner).

b. Instruction sign, 9"x3¼", with the inscription, "TO BEGIN, PLEASE PUT ON THE EAR PHONES, AND THEN PUSH DOWN BUTTON NUMBER ONE ON THE TAPE RECORDER." (Upper, center).

c. Pictoral Riddle sign, 5"x7¼", showing a three colored cartoon of the earth showing the tilted axis by means of a black line at the poles, and having the inscription, "WHAT IS IT? It's tilted it's true, But that's OK with me, Because its tilt, Brings VARIETY!". (Middle, left side).

d. Colored diagram of the earth in its orbit around the sun, showing the sun and earth in ten different positions, (Middle, right side.) with four positions, labeled, "SPRING, SUMMER, FALL, WINTER."

e. Chart, 8½"x11", entitled, "DAYLENGTH CHANGE WHERE YOU LIVE", and showing, for the 42 degree, 27 minutes North latitude, in separate columns for the fifteenth day of each month, the following information:

1. Date.
2. Time of sunrise.
3. Time of sunset.
4. Total daylength in hours and minutes.
5. A horizontal "bar graph" comparing daylength in yellow, with length of night in black or gray.

(The daylength change chart is positioned on the Bottom, left side of the bulletin board.)

f. Pictoral diagram, 4"x6¼", labeled "PICTURE A", showing a view of the earth above the north pole on a winter day, upon which is shown twenty-four equidistant dots in a ring around the north pole, drawn at the forty second degree, twenty-seven minute parallel. Direction of impinging sunlight is illustrated and labeled. At the bottom of the diagram are the words, in 5/16" capital letters, "A VIEW OF THE EARTH ABOVE THE NORTH POLE ON A WINTER DAY." (Middle-bottom, left side).

g. Pictoral diagram, 4"x6¼", labeled, "PICTURE B", showing a view of the earth above the north pole on a summer day, upon which is shown twenty-four equidistant dots in a ring around the north pole, drawn at the forty-second degree twenty-seven minute parallel. Day and night areas of the earth are indicated by yellow and black areas, respectively. The direction of impinging sunlight is illustrated and labeled. At the bottom of the diagram are the words, in 5/16" capital letters, "A VIEW OF THE EARTH ABOVE THE NORTH POLE ON A SUMMER DAY." (Bottom, left side).

2. Color Slides, Kodachrome and Ektachrome, (35mm and 28mm x 28mm), six in number, each enclosed in a 2"x2" KIMAC brand plastic slide pro-

tector, and labeled by means of a self-adhesive plastic label, with consecutive numbers from one through six. A brief description of each of the color slides follows: (author's slide, unless indicated)

a. Slide 1. A young boy flying a kite in the spring. (R.B. Fischer)

b. Slide 2. Two girls making a sand castle on a beach with the Atlantic Ocean shown in the background.

c. Slide 3. Five elementary school and junior high school aged boys playing football in the autumn.

d. Slide 4. An elementary school aged boy shown holding a fish taken while ice fishing in the winter, and showing other fish on the ice covered lake around him. (Mr. Donald J. Wagner)

e. Slide 5. A copper kettle is shown sitting on the top of a gas stove, near a stove top burner.

f. Slide 6. Two elementary aged school children, shown sunbathing in the summer. One girl is shown lying flat on a pad on the ground, and the other is shown in a lawn lounge chair beside the first girl.

3. Sun-Earth Shadow Box. Length, width and depth, respectively are $11\frac{1}{2}$ inches by 8 inches by 9 inches. The floor or bottom is made from $\frac{1}{2}$ inch pine, and the sides from $\frac{1}{4}$ inch plywood. A seven watt white Christmas tree (indoor) light bulb used to simulate the sun, is mounted in a plastic on-off switch receptacle in the center of the box. A ping-pong ball with twenty-four equidistant spaced India ink dots drawn in a circle at forty-two degrees North latitude, serves as a model earth. The earth model is movable, and is mounted on a three inch brass rod which is imbedded 1 inch, with two inches exposed, in a 2 3/8 inch long wooden $\frac{1}{2}$ inch dowel base. The brass rod, $1\frac{1}{2}$mm in diameter, simulates the earth's axis and the ping-pong ball earth model can revolve on the brass axis. Four pairs of 9/16 inch holes drilled in the floor of the box, and the other of each pair was drilled at $66\frac{1}{2}$ degrees, all inclined in the same direction and all in a plane parallel to the long axis of the box. The 90 degree holes, are identified with bright yellow paint. One pair of dowel receiving holes is labeled "September" and the others are labeled either "December", "March", or June." A three foot electric cord with plug runs through a groove in the underside of the floor of the box, and enters the sun model light bulb receptacle via the bottom of the box. The inside of the Sun-Earth model is painted dull black, and the outside is painted bright yellow. A heavy cardboard lid, having four 7/8 inch diameter viewing holes positioned over the ping-pong ball earth model positions, accompanies the box model for use in areas of abnormally intense overhead illumination.

4. Audio-taped Lesson. Twenty-six minute audio lesson on Norelco brand, Model C-60 tape cassette. The script for Autumn Lesson Two can be found in the Appendix, under the heading of "Lesson Scripts."

AUTUMN LESSON NUMBER THREE. SOFTWARE.

1. Bulletin Board, portable, 23½"x19¼"x¼", containing the following color photographs, signs, and diagrams, in the positions indicated in parentheses:

    a. Lesson Label, 1¼"x2", with the inscriptions, "ENVIRONMENTAL EDUCATION - FALL PROGRAM - LESSON THREE." (Top, left corner).

    b. Instruction sign, 9"x3¼", with the inscription, "TO BEGIN, PLEASE PUT ON THE EAR PHONES, AND THEN PUSH DOWN BUTTON NUMBER ONE ON THE TAPE RECORDER." (Upper, center).

    c. Sign, 2¼"x16", and the inscription, "WHERE HAVE ALL THE FLOWERS GONE? (AND THE FROGS AND WATERFOWL, TOO?)".

    d. Color photograph, 5"x7", of a close-up view of the flowers of New England Aster. (Center, left side).

    e. Cartoon diagram, 9"x7", showing a green frog and a white duck looking at their wrist watches, with the frog saying, "I'd say that you have about 8 weeks before migration time, and I've got 6 weeks before hibernating!". (Center, center).

    f. Color photograph, 5"x7", of a close-up view of an Eastern Chipmunk eating an ear of corn. (Center, right side).

    g. Color photograph, 5"x7", of a close-up view of Common Milkweed fruits and seeds. (Bottom, left side).

    h. Color photograph, 5"x7", of a close-up view of the fruit and foliage of Climbing Bittersweet. (Bottom, center).

    i. Color photograph, 5"x7", of a close-up view of the fruit of Meadow Avens. (Bottom, right side).

2. Color Slides, Kodachrome and Ektachrome, 2"x2" (35mm and 28mm x 28mm), thirteen in number, each slide enclosed in a 2"x2" KIMAC brand plastic slide protector, and labeled by means of self-adhesive plastic label-maker numbers, with consecutive numbers from one through thirteen. A brief description of each of the color slides follows: (photograph by author unless otherwise indicated)

    a. Slide 1. A field of Canada Goldenrod in flower. (R.B. Fischer)

    b. Slide 2. A close-up view of the fruit of one Canada Goldenrod plant.

    c. Slide 3. The flowers and foliage of Common Milkweed.

    d. Slide 4. An elementary school girl standing beside a hybrid Sunflower plant in flower.

e. Slide 5. A close-up view of the fruits and fruiting head of Sunflower.

f. Slide 6. A close-up view of the flower of Apple. (Commercial)

g. Slide 7. A view of five ripe apples on a branch of an apple tree.

h. Slide 8. A close-up view of a longitudinal-section of an early development stage of an apple fruit, showing stamens and pistils of the apple flower. (Commercial)

i. Slide 9. A close-up view of a cross section and a longitudinal-section of apple fruit.

j. Slide 10. A view of apple, tomato, cucumber, and grade fruits.

k. Slide 11. A close-up view of cross-sections of tomato and cucumber fruits, showing seeds in each.

l. Slide 12. A view of the foliage and fruit of the Wild Rose.

m. Slide 13. A view of the foliage and fruit of the Wild Leafed Cattail.

3. *Carrel Library*. The carrel library includes a 4"x6" plastic file box and five paperback books which are housed in the file box when they are not in use. The books, each 160 pages in length, are from the Golden Nature Guide series, published by the Golden Press, New York. A list of the titles and authors follows:

   a. *Mammals*, by Herbert S. Zim and Donald F. Hoffmeister, copyright 1955.

   b. *Reptiles and Amphibians*, by Herbert S. Zim and Hobart M. Smith, copyright 1956.

   c. *Birds*, by Herbert S. Zim and Ira N. Gabrielson, copyright 1956.

   d. *Trees*, by Herbert S. Zim and Alexander C. Martin, copyright 1956.

   e. *Flowers*, by Herbert S. Zim and Alexander C. Smith, copyright 1950.

4. *Audio-taped Lesson*. Twenty-seven minute audio lesson on Norelco brand, Model C-60 tape cassette. The script for Autumn Lesson Three can be found in the Appendix under the heading of "Lesson Scripts."

AUTUMN LESSON NUMBER FOUR, SOFTWARE.

1. Bulletin Board, portable, 23½"x19¼"x¼", containing the following color photographs and black print on white signs in the positions indicated in parentheses:

   a. Lesson label, 1¼"x2", with the inscription, "ENVIRONMENTAL EDUCATION - FALL PROGRAM - LESSON FOUR." (Top, left corner).

   b. Instruction sign, 9"x3¼", with the inscriptions, "TO BEGIN, PLEASE PUT ON THE EAR PHONES, AND THEN PUSH DOWN BUTTON NUMBER ONE ON THE TAPE RECORDER." (Upper, center).

   c. Color photograph, 5"x7" of a close-up view of a Red Maple twig, showing axial buds, terminal bud, and leaf petioles. (Center, left side).

   d. Color photograph, 5"x7", of a Sugar Maple tree, showing the autumn yellow color of Sugar Maple leaves. (Center, center).

   e. Color photograph, 5"x7", of an ultra close-up view of a Red Maple twig, showing terminal bud, lateral buds, and leaf scars. (Center, right side).

   f. Color photograph, 5"x7", of a Black Duck on a hunting coat. (Bottom, left side).

   g. Color photograph, 5"x7", of a close-up view of Red Maple leaves, showing autumn red color of Red Maple leaves in a natural setting. (Bottom, right side).

2. Book, paperback, 160 pages, titled Insects, by Herbert S. Zim and Clarence Cottam, copyright 1956. This is one of the Golden Nature series, published by the Golden Press, New York.

3. Woody twigs, 4 inches in length, in a plastic box (2½"x2½x2x3") container. One each of Shagbark Hickory, White Ash, and Black Walnut twigs, cut in early autumn and displaying buds and leaf scars of the current year. Each twig is labeled with colored plastic tape.

4. Color Slides. Kodachrome and Ektachrome (35mm and 28mm x 28mm), 2"x2", seventeen in number, each enclosed in a 2x2 KIMAC brand plastic slide protector, and labeled by means of a self-adhesive plastic label with consecutive numbers from one through seventeen. A brief description of each of the color slides follows:

   a. Slide 1. A view of a partly plucked drake Mallard duck.

   b. Slide 2. A close-up view of a Banded Woolly Bear caterpillar.

   c. Slide 3. A close-up view of a Snowy Tree Cricket.

d. Slide 4. A close-up view of a Katydid mounted on a white card.

e. Slide 5. A view of a metal and wire insect cage containing a collection of Brown Field Crickets, bedding material, a watering device, and a food pan.

f. Slide 6. A close-up view of a Whitetail Deer track in mud.

g. Slide 7. A view of plaster cast tracks of Black Bear and Raccoon.

h. Slide 8. A view of a bleach bottle bird feeding station.

i. Slide 9. A view of an "owl" paperweight made from a granite cobblestone, colored felt, and paint, by an elementary school student.

j. Slide 10. A view of an autumn dried flower and dried fruit arrangement.

k. Slide 11. A photograph of a bulletin board display of dried and pressed leaves collected in the autumn.

l. Slide 12. A photograph of four brush and scatter prints of common tree leaves.

m. Slide 13. A close-up view of a Red Maple twig with four leaves, picked in late summer.

n. Slide 14. A closer view of the Red Maple twig of the previous slide, showing buds and leaf petioles.

o. Slide 15. An ultra close-up view of the surface of one of the leaves of slide 13, showing leaf veins.

p. Slide 16. A view of Poison Ivy in the autumn, shown attached to a tree trunk. (photograph by Professor Richard B. Fischer)

q. Slide 17. A picture of a variety of field trip collecting containers, such as plastic bags, milk cartons, tin cans, paper pie plates, inexpensive plastic containers, and newspapers.

5. Audio-taped Lesson. Twenty-eight minute audio lesson on a Norelco brand, Model C-60 tape cassette. The script for Autumn Lesson Four can be found in the Appendix under the heading, "Lesson Scripts."

WINTER LESSON NUMBER ONE, SOFTWARE.

1. Bulletin board, portable, 23½" x 19¼" x ¼", containing the following black print on white signs (xerox copies) and color chart, in the positions indicated in parentheses:
    a. Lesson label, 1¼" x 2", with the inscription, "ENVIRONMENTAL EDUCATION - WINTER PROGRAM - LESSON ONE." (Top, left corner)
    b. Instruction sign, 9" x 3¼", with the inscription, "TO BEGIN, PLEASE PUT ON THE EAR PHONES, AND THEN PUSH DOWN BUTTON NUMBER ONE ON THE TAPE RECORDER." (Upper, center)
    c. An enlarged color copy of the Food Council of America, "Four Basic Foods" symbol, in the form of a hand drawn chart, 14" x 20" in size, and having the inscription, "EAT THE BASIC 4 FOODS EVERY DAY." (Center)

2. A one pound bag of selected deer browse, containing small twigs of red maple, a variety of dogwoods, and hemlock, enclosed in a clear plastic bag fastened with heavy rubber bands.

3. Color slides, Kodachrome and Ektachrome, 2" x 2", twenty in number, each encased in a 2" x 2" KIMAC brand clear plastic slide protector, and labeled by means of a self-adhesive plastic label-maker number, with consecutive numbers from one through twenty. A brief description of each of the color slides follows: (Photograph by the author unless otherwise indicated)
    a. Slide 1. A women and two small children hiking on a trail in a hardwood woodlot on a sunny winter day.
    b. Slide 2. A dining room table set with dinnerware and having a paper turkey decoration as a centerpiece.
    c. Slide 3. Seven people sitting at, or standing near the table shown in slide two. In this view the paper turkey has been replaced with a large roast turkey.
    d. Slide 4. A winter bird feeding station with a variety of winter resident songbirds.
    e. Slide 5. A close view of an ear of field corn on a corn plant in a field of unharvested field corn.
    f. Slide 6. Corn cobs and husks laying with dried leaves as the base of a tree.
    g. Slide 7. A close view of a gray squirrel. (Commercial slide)
    h. Slide 8. A close view of a red squirrel. (Professor Richard B. Fischer)
    i. Slide 9. A close view of a deermouse on staghorn sumac fruit. (Commercial slide)
    j. Slide 10. A close view of a small pile of northern red oak acorns.

k. Slide 11. A close view of a blue jay. (Commercial slide)

l. Slide 12. A close view of a black-capped chickadee. (Commercial)

m. Slide 13. A close view of a male cardinal. (Commercial)

n. Slide 14. A close view of a barred owl. (Commercial slide)

o. Slide 15. A close view of owl pellets. One pellet is partially broken, exposing a number of mouse bones and teeth.

p. Slide 16. A close view of a downy woodpecker. (Commercial)

q. Slide 17. A close view of a white-breasted nuthatch. (Commercial)

r. Slide 18. A close view of the face of an adult raccoon. (Commercial slide)

s. Slide 19. A close view of a cottontail rabbit browsed oak tree sapling.

t. Slide 20. A white-tailed deer doe in winter. (Commercial)

4. Audio-taped Lesson. Twenty-seven minute audio lesson on a Norelco brand, Model C-60 tape cassette. The script for winter lesson one can be found in the Appendix under the heading, "Lesson Scripts."

WINTER LESSON NUMBER TWO, SOFTWARE.

1. Bulletin board, portable, 23½" x 19¼" x ¼", containing the following black print on white signs (xerox copies) and colored chart, in the positions indicated in parentheses:

   a. Lesson label, 1¼" x 2", with the inscription, "ENVIRONMENTAL EDUCATION - WINTER PROGRAM - LESSON TWO." (Top, left corner)

   b. Instruction sign, 9" x 3¼", with the inscription, "TO BEGIN, PLEASE PUT ON THE EAR PHONES, AND THEN PUSH DOWN BUTTON NUMBER ONE ON THE TAPE RECORDER." (Upper, center)

   c. Chart, 14" x 15" in size. This is an exact copy of the gameboard of the winter wildlife ecology game, "How Was Your Winter". (Center)

2. Color slides, Kodachrome and Ektachrome, 2" x 2", twenty in number, each encased in a 2" x 2" KIMAC brand clear plastic slide protector, and labeled by means of a self-adhesive plastic label-maker number, with consecutive numbers from one through twenty. A brief description of each of the color slides follows: (photograph by the author unless otherwise indicated)

   a. Slide 1. A deer path in snow, leading into a field of unharvested field corn. (photograph by Professor Richard B. Fischer)

   b. Slide 2. The margin of a ten year old Norway spruce planatation and a weedy field, in winter.

c. Slide 3. The brushy edge of a young mixed hardwood-conifer woods in winter.

d. Slide 4. A lumbered out opening in a mature hardwood woodlot in winter.

e. Slide 5. A close view of red maple saplings growing from a stump, in winter.

f. Slide 6. A mature stand of Norway spruce in winter.

g. Slide 7. A brushy, weedy, stream bank in winter.

h. Slide 8. A brush pile in winter.

i. Slide 9. A view of a hollow hardwood tree, among some younger hardwood trees, in winter.

j. Slide 10. A view of a leafy gray squirrel nest in a white oak tree, in winter.

k. Slide 11. A variety of ducks, geese, and a single swan, in a small ice-free portion of a pond, and on the ice and snow covered surface of the pond.

l. Slide 12. A view of a beaver lodge in the winter.

m. Slide 13. A close view of a robin nest on a two by four of an abandoned building, in winter.

n. Slide 14. A brushy field, mostly varieties of Viburnum and Cornus, showing a snow-capped goldfinch nest in the background.

o. Slide 15. A close view of the snow-capped nest in slide 14.

p. Slide 16. A close view of a red-wing blackbird nest in winter, occupied by a deermouse, and showing the mouse's entrance hole in the side of the bird nest.

q. Slide 17. This is the same as slide 16, except it shows a close view of a deermouse leaping from the nest entrance.

r. Slide 18. A view of a young girl looking at a white-faced hornet nest in a low bush in the winter.

s. Slide 19. A Forsythia bush in bloom in the spring. (photograph by Professor Richard B. Fischer)

t. Slide 20. The same Forsythia bush. This photograph was taken on another spring when only the flower buds on the lowest branches survived late winter freezing, and were in bloom. (photograph by Professor Richard B. Fischer)

4. Audio-taped Lesson. Twenty-seven minute audio lesson on a Norelco brand, Model C-60 tape cassette. The script for winter lesson two can be found in the Appendix under the heading, "Lesson Scripts."

5. Game. The winter wildlife ecology game titled, "How Was Your Winter," was designed for and used as a supplementary activity to

the winter program. A description of the game, including game directions and rules, can be found in the Appendix under the heading, "Winter Wildlife Ecology Game."

WINTER LESSON NUMBER THREE, SOFTWARE.

1. Bulletin board, portable, 23½" x 19¼" x ¼", containing the following black print on white signs (xerox copies) and enlarged, 5" x 7" black and white photographs, in the positions indicated in parentheses: (photographs by the author unless otherwise indicated)

   a. Instruction sign, 9" x 3¼", with the inscription, "TO BEGIN, PLEASE PUT ON THE EAR PHONES, AND THEN PUSH DOWN BUTTON NUMBER ONE ON THE TAPE RECORDER." (Upper, center)

   b. Bulletin board photograph quiz answer chart, 8¼" x 5½", with the heading, "WHOSE SIGN IS THIS? CHECK YOUR ANSWERS BELOW". Below the heading label, the chart as the following eight labeled, "fold-back" photograph identification labels:

      1. Pileated Woodpecker
      2. Meadow Vole
      3. Squirrel
      4. Songbirds
      5. Cottontail Rabbit
      6. Muskrat
      7. Muskrat
      8. Weasel

      Each of the above labels was constructed from pieces of tag board, 1½" x 4" in size, and was folded along the long dimension and glued to the answer chart. (Lower, center)

   c. Photograph number one, showing a white pine tree which has four large holes made by a pileated woodpecker. (Upper, left)

   d. Photograph number two, showing a meadow vole tunnel and tracks in snow. (Middle, left)

   e. Photograph number three, showing gray squirrel tracks in snow. (Lower, left)

   f. Photograph number four, showing songbird tracks in snow. (Upper, center, under the instruction sign)

   g. Photograph number five, showing cottontail rabbit tracks in snow. (Center, above quiz answer chart)

   h. Photograph number six, showing an exit hole on the surface of an ice covered pond, and muskrat tracks leading from the hole. (Upper, right)

   i. Photograph number seven, showing a close view of muskrat tracks in snow. (Middle, right)

   j. Photograph number eight, showing weasel tracks in snow. (Lower, right)

2. Color slides, Kodachrome and Ektachrome, 2" x 2", twenty in number, each encased in a 2" x 2" KIMAC brand clear plastic slide protector, and labeled by means of a self-adhesive plastic label-maker number, with consecutive numbers from one through twenty. A brief description of each color slide follows: (photograph by the author unless otherwise indicated)

    a. Slide 1. Cottontail rabbit tracks in deep snow.

    b. Slide 2. A close view of a single set of cottontail tracks in snow.

    c. Slide 3. A close view of four ring-necked pheasant footprints in snow. (R.B. Fischer)

    d. Slide 4. Cottontail rabbit and ring-necked pheasant tracks in snow. (R.B. Fischer)

    e. Slide 5. A view of rabbit scat in snow.

    f. Slide 6. A view of white-tailed deer scat in snow. (R.B. Fischer)

    g. Slide 7. A deer bed in snow with a pack basket for size comparison.

    h. Slide 8. A close view of a deer footprint in mud at the edge of the deer bed in slide 7.

    i. Slide 9. Deermouse tracks in snow with a glove for size comparison.

    j. Slide 10. A view of the entrance to a meadow vole or shrew tunnel in snow, with a goldenrod gall ball for size comparison.

    k. Slide 11. A close view of songbird footprints and wingprints in snow.

    l. Slide 12. A view of a line of domestic cat tracks in snow.

    m. Slide 13. A close view of a set of four domestic cat footprints in snow.

    n. Slide 14. A close view of two dog footprints in snow. (R.B. Fischer)

    o. Slide 15. A close view of a set of gray squirrel tracks in snow.

    p. Slide 16. Gray Squirrel tracks in deeper snow, leading to the base of a tree.

    q. Slide 17. Squirrel tracks in deeper snow, leading to a spot where the squirrel dug in the snow.

    r. Slide 18. Ruffed grouse roosting place and path in snow.

    s. Slide 19. Muskrat tracks in snow leading to a hole.

    t. Slide 20. Snow mobile tracks on a snow covered hillside. (Professor Richard B. Fischer)

3. Audio-taped Lesson. Twenty-eight minute audio lesson on a Norelco brand, Model C-60 tape cassette. The script for winter lesson three can be found in the Appendix under the heading, "Lesson Scripts".

SPRING LESSON NUMBER ONE, SOFTWARE

1. Bulletin board, portable, $23\frac{1}{2}$" x $19\frac{1}{4}$" x $\frac{1}{4}$", containing the following black print on white signs (xerox copies) and color illustration, in the positions indicated in parentheses:
   a. Lesson label, $1\frac{1}{4}$" x 2", with the inscription, "ENVIRONMENTAL EDUCATION - SPRING PROGRAM - LESSON ONE". (Top, left corner)
   b. Instruction sign, 9" x $3\frac{1}{4}$", with the inscription, "TO BEGIN, PLEASE PUT ON THE EAR PHONES, AND THEN PUSH DOWN BUTTON NUMBER ONE ON THE TAPE RECORDER". (Upper, center)
   c. Color illustration, 17" x 11", a reprint of the center spread article illustration by Wayne Trimm, staff artist of the New York State Environmental Conservation official magazine, the CONSERVATIONIST. The illustration features nineteen separate drawings of selected wildlife babies, and has the caption, "Spring Babies". The illustration accompanied the article entitled, "Another Spring -- Another Generation" and written by Dr. Verne Rockcastle for the April-May, 1957 issue of the CONSERVATIONIST. (Center)
   d. Sign, 8" x $3\frac{1}{2}$", with the inscription, "WILDLIFE BABIES ARE FUN TO SEE -- BUT PLEASE LEAVE THEM OUTDOORS WHERE THEY CAN LIVE FREE". (Lower, center)

2. Color slides, Kodachrome and Ektachrome, 2" x 2", fifteen in number, each encased in a 2" x 2" KIMAC brand clear plastic slide protector, and labeled by means of a self-adhesive plastic label-maker number, with consecutive numbers from one through fifteen. A brief description of each of the slides follows: (photographs by the author unless otherwise indicated)
   a. Slide 1. A close view of tulip plants in flower.
   b. Slide 2. A picture of a redbud tree in blossum.
   c. Slide 3. A view of the top of a red maple tree in early spring when its flowers were beginning to bloom.
   d. Slide 4. A close view of red maple flowers.
   e. Slide 5. A close view of an American elm twig, showing developing leaf buds and pistillate flowers.
   f. Slide 6. A close view of the candle-like branch of an Austrian pine. (Commercial slide)
   g. Slide 7. A view of a young cottontail rabbit. (R. B. Fischer)
   h. Slide 8. A view of a newly born mule deer fawn, partially hidden in woodland undergrowth.
   i. Slide 9. A picture of a girl putting a bird house in a tree.
   j. Slide 10. A close view of an adult robin at a nest with young robins. (Commercial slide)

k. Slide 11. A close view of a pair of mallard ducks in spring plumage.

l. Slide 12. A view of a male field sparrow, shown while singing from a dried giant mullein stock in the spring.

m. Slide 13. A close view of a red-winged blackbird nest containing three eggs.

n. Slide 14. A view of a female red-winged blackbird at a nest with a nestling bird. (Commercial slide)

o. Slide 15. A view of a male red-winged blackbird at a nest with a nestling bird. (Commercial slide)

3. Audio-taped Lesson. Twenty-eight minute audio lesson on a Norelco brand, Model C-60 tape cassette. The script for spring lesson one can be found in the Appendix under the heading, "Lesson Scripts".

SPRING LESSON NUMBER TWO, SOFTWARE

1. Bulletin board, portable, 23½" x 19¼" x ¼", containing the following black print on white signs (xerox copies) and 5" x 7" color photographs in the positions indicated in parentheses:
   a. Lesson label, 1¼" x 2", with the inscription, "ENVIRONMENTAL EDUCATION - SPRING PROGRAM - LESSON TWO". (Top, left corner)
   b. Sign, 6" x 3½", entitled, "AMPHIBIANS", and listing the following; "FROGS, TOADS, SALAMANDERS". (Middle, left side)
   c. Sign, 6" x 3½", entitled, "REPTILES", and listing the following; "SNAKES, LIZARDS, TURTLES, CROCODILES, ALLIGATORS". (Middle, right side)
   d. Color photograph of a young girl holding, and looking at, a garter snake. (Middle, center)
   e. Color photograph of a young girl holding, and looking at, an eastern painted turtle. (Lower, right side)
   f. Color photograph showing a close view of a spring peeper on moss. (Lower, left side) This photograph is from a slide photographed by Professor Richard B. Fischer.

2. Carrel Library. The carrel library includes a 4" x 6" plastic file box and two paperback books which are housed in the file box when they are not in use. The books, each 160 pages in length, are from the Golden Nature Guide series, published by the Golden Press, New York. Included are the following books:
   a. Pond Life, by George K. Reid, Herbert S. Zim, and George S. Fichter, copyright 1967.
   b. Reptiles and Amphibians, by Hertert S. Zim and Hobart M. Smith, copyright 1956.

3. Color slides, Kodachrome and Ektachrome, 2" x 2", twelve in number, each encased in a 2" x 2" KIMAC brand clear plastic slide protector, and labeled by means of a self-adhesive plastic label-maker number, with consecutive numbers from one through twelve. A brief description of each of the slides follows: (photographed by the author unless otherwise indicated)

   a. Slide 1. A view of a male American toad in the process of singing. (Photographed by Professor Richard B. Fischer)

   b. Slide 2. A view of mating American toads, showing the female depositing two strings of eggs. (Richard B. Fischer)

   c. Slide 3. A close view of egg masses of a wood frog and a spotted salamander. (Richard B. Fischer)

   d. Slide 4. A magnified view of an American toad tadpole at a stage of development in which only its hind legs are visible.

   e. Slide 5. A magnified view of an American toad tadpole at a stage of development in which both its front and hind legs are readily visible.

   f. Slide 6. A close view of an adult spotted salamander. (Richard B. Fischer)

   g. Slide 7. A view of a red eft.

   h. Slide 8. A close view of an eastern painted turtle. (Richard B. Fischer)

   i. Slide 9. A close view of a meadow frog. (Richard B. Fischer)

   j. Slide 10. A close view of a green frog. (Richard B. Fischer)

   k. Slide 11. A close view of a bullfrog. (Richard B. Fischer)

   l. Slide 12. A close view of a tree toad on a birch tree. (Richard B. Fischer)

4. Audio-taped Lesson. Twenty-seven minute audio lesson on a Norelco brand, Model C-60 tape cassette. The script for spring lesson two can be found in the Appendix under the heading, "Lesson Scripts".

SPRING LESSON NUMBER THREE, SOFTWARE

1. Bulletin board, portable, 23½" x 19¼" x ¼", containing the following black print on white signs (xerox copies) and 5" x 7" color photographs in the positions indicated in parentheses:

a. Lesson label, 1¼" x 2", with the inscription, "ENVIRONMENTAL EDUCATION - SPRING PROGRAM - LESSON THREE". (Top, left corner)

b. Instruction sign, 9" x 3¼", with the inscription, "TO BEGIN, PLEASE PUT ON THE EAR PHONES, AND THEN PUSH DOWN BUTTON NUMBER ONE ON THE TAPE RECORDER". (Upper, center)

c. Sign, 6¼" x 3", entitled, "POND ANIMALS YOU CAN FIND", and listing the following: "MICROORGANISMS, WORMS, INSECTS, CRAYFISH, SNAILS, FROGS, TURTLES, FISH, AND MANY MORE". (Middle, left side)

d. Sign, 6¼" x 3", entitled, "IN POND WATER YOU CAN FIND", and listing the following: "PLANTS - THE FOOD MAKERS, PREDATORS, PARASITES, PLANT EATERS, SCAVENGERS, DECOMPOSERS". (Middle, right side)

e. Color photograph showing a magnified view of an adult dragonfly resting on iris leaves. (Middle, center)

f. Color photograph showing a magnified, underwater view of an adult water scorpion. (Lower, left-side)

g. Color photograph showing a magnified, underwater view of a dragonfly nymph. (Lower, right-side)

2. Carrel Library. The carrel library includes a 4" x 6" plastic file box and two paperback books which are housed in the file box when they are not in use. The books, each 160 pages in length, are from the Golden Nature Guide series, published by the Golden Press, New York. Included are the following books:

   a. Pond Life, by George K. Reid, Herbert S. Zim, and George S. Fichter, copyright 1967.

   b. Insects, by Herbert S. Zim and Clarence Cottam, copyright 1956.

3. Color slides, Kodachrome and Ektachrome, 2" x 2", ten in number, each encased in a 2" x 2" KIMAC brand clear plastic slide protector, and labeled by means of a self-adhesive plastic label-maker number, with consecutive numbers from one through ten. A brief description of each of the slides follows: (photographs are by the author unless otherwise indicated)

   a. Slide 1. A picture of pond sampling equipment, consisting of a medicine dropper, a trowel, a minnow dipper, and a soup strainer.

   b. Slide 2. A teenage girl using a soup strainer to collect pond life at the edge of a pond.

c. Slide 3. A close view of a milk carton aquarium containing pond plants in pond water.

d. Slide 4. A close underwater view of the dorsal side of a water bug just under the surface.

e. Slide 5. A life-size underwater view of the dorsal side of a backswimmer.

f. Slide 6. A close view of an adult damselfly on a weed.

g. Slide 7. A life-size underwater view of a damselfly nymph.

h. Slide 8. A close view of a milk carton aquarium containing a damselfly nymph, a mayfly nymph, and a penny.

i. Slide 9. A close view of a milk carton aquarium containing three caddisfly larvae and a penny.

j. Slide 10. A life-size underwater view of an adult predaceous diving beetle.

4. Audio-taped Lesson. Twenty-six minute audio lesson on a Norelco brand, Model C-60 tape cassette. The script for spring lesson three can be found in the Appendix under the heading, "Lesson Scripts".

LESSON SCRIPTS

AUDIO-TAPED SCRIPT, AUTUMN LESSON NUMBER ONE

Hello. I hope you are feeling fine today. This is the first lesson of a series of lessons that I've prepared to help you get ready for some outdoor field trips. I think the best way to learn about our earth, and about how animals and plants live, is to go outdoors -- to go to the vacant lots, fields, gardens, yards, forests, streams, lakes, and the like, where most living things do live. And where living things behave normally. Animals in cages, and well watered plants in lighted green houses, don't always behave normally.

Before we go any further, I'd like to give you some information about the tape recorder. If my voice is too loud or too soft, move the volume wheel on the right side of the tape recorder. Have you found the little black wheel with its white numbers? You can move it to a number where the sould of my voice seems OK to you. If you want to stop the tape recorder during the lesson, just push down hard on the STOP button on the front of the recorder. To start again, push on the PLAY button. At the end of this lesson you will be asked to push the REWIND button. The rewind button will cause the tape to wind back to the beginning, so that the next person can start the lesson from the beginning.

Give the STOP button a push, and then push the PLAY button to hear my voice again. (PAUSE)

This lesson, and those to follow, are to help you understand how the things you can see living in the outdoors, live -- and why they do the interesting things they do. When you and the other members of your class have finished the autumn lessons, you'll be taken outdoors on a field trip. Please don't feel that you can't, or shouldn't go on field trips with your friends before or after your class trip. Field trips with family or friends can be fun and interesting any time of the year.

Do you see the colored photographs in the carrel? In one picture there is a girl collecting some most interesting stream life while on a fall field trip with her class. Another picture shows three children about to depart on an autumn hike and field trip to a forest lookout tower. All these people found strange and wonderful things on their trips.

When you are finished with the autumn lessons, you should know more about some of the plants that live around you. You will be able to collect fruits and seeds for growth experiments at home or at school. You should also be able to explain why some birds, mammals, and other animals you can see outdoors, behave as they do in the fall. You should be able to find some singing insects by their sounds -- and maybe you'll be able to identify some of them. You may want to collect some bugs for studying, and you'll be able to read about the fascinating ways they, and other animals get ready for winter.

Colorful leaves, like those in the photograph, are a part of the outdoors in autumn. Many different kinds can be found within easy reach as they fall to the ground. You will know more about WHY many plants lose their leaves in the fall, and what causes them to change color. You may want to do some leaf collecting for making fall displays, or for tree identification, or for a lovely collection.

On a field trip you should have a chance to look at some different soils and collect some soil that you can use to plant seeds in later. Going outdoors will give you a chance to explore all sorts of things about our environment. Your own imagination will lead you to all kinds of interesting detective work in the outdoors. Your library books, friends, teachers, and parents will be able to help you explore even further.

I'm going to talk for a few more minutes to introduce our lesson for today. In a short time, I'll tell you how and when to use the slides and the slide viewer.

As far as we know today, LIFE -- people, plants, animals, and tiny living things we call microorganisms, live only on our planet, EARTH. I imagine that you've studied about the earth, and know that it is like a space-ship that travels round and round the sun. Many other "space-ship" like bodies travel in space too. Do you remember any of the Apollo space trips to the moon? The Apollo astronauts, living in their space vehicle for a time, had to get all the things they needed to stay healthy -- even to stay alive -- from materials carried with them in their space vehicle. We too, here on earth, have to get materials from our space-ship, EARTH, to stay healthy. In using their materials, the astronauts had to follow many rules. They had to use their materials only at certain times and in certain amounts, in order to have enough for their entire trip. Do you remember the dangers faced by the Apollo Thirteen crew when things went wrong with their ship?

Some things seem to be going wrong on our space-ship, earth. Even though earth is much larger than a space capsule, earth too have rules that must be followed so that we "earth-bound" spacemen will continue to have the materials and living conditions needed to stay healthy.

In the past, when there were fewer people on earth, we thought we had enough materials that we didn't have to worry about wasting the earth's materials. We also had much to learn about the rules that living things have to follow in order to make GOOD USE of the earth's materials. Did you know that today we people are increasing in numbers by over one million each week?! With the earth becoming very crowded, we know that we must carefully study the rules by which plants, animals, and microorganisms have lived so long, because they have gotten along very well for hundreds of thousands of years -- and all this time, they have been using and reusing the earth's materials.

Pollution is ONE of earth's problems. Most kinds of pollution that we PEOPLE have created, are the results of our breaking the earth's rules in using earth materials. New knowledge that you and I and others can discover will help us plan our use of the earth's materials. This knowledge will give us a good chance of living enjoyable lives, and it will even improve the lives of many thousands of people who are not as lucky as you and I, and many others who have not yet been born!

Scientists have been taking a good look at animals, plants, and microorganisms of all kinds. Can you guess what they have found? Even though the many different kinds of living things have many, many different ways of living, all the ways of living are also ALIKE! All the WAYS OF LIVING are designed to use the earth's materials in ways that help the living things survive and produce new living things. People are being investigated carefully, too. We now know that the workings of OUR BODIES are much like what goes on in plants, animals, and even what goes on inside of microorganisms! PEOPLE TOO need the materials and living conditions that the earth offers.

What are some of the earth's materials and conditions that living things need? What are the "life requirements" the earth provides? I'd like to use some colored slides to help answer these questions.

Let's take a moment to learn how to use the slide viewer. Find the viewer and the set of colored slides in the box near the viewer. You'll notice that the slides are numbered. Now look at the top of the slide viewer, near its back. Did you find a slot for slides, and a white plastic bar behind the slot? Push the white bar down. Did the viewer light up? Push the bar down and away from you a bit, and the bar will stay down and the light will remain on. Try this if you haven't already. When the light is on, you can push the bar toward you a little and the bar will come up again, and the light will turn off. Now take slide number ONE and put it into the slot in the viewer. Push the top edge of the slide AND the top of the bar down together. To get the slide out, you can push the top of the bar toward you and the slide will pop up far enough for you to take it out. If you are handier with your fingers than I am, you will be able to put slides in and take them out while the bar remains down and the light on.

When I tell you to stop, push the STOP button on the recorder and practice using the slide viewer with slide number one. Practice for a minute if you think its necessary, and when you are finished practicing, push the PLAY button on the tape recorder to hear my voice again, and we'll continue. Push the stop button now. (PAUSE)

If slide one is not in the viewer, put it there now and we'll use it. Slide one shows two girls on a field trip, investigating the life in a tidal pool near the Atlantic seashore. Does it look like they're having fun? One of the life requirement materials is shown here. What do you think it is? WATER it is. The sea water and the sea water stranded in the small pool when the tide is out, provide this earth material for countless living things that are adapted to using salt water. You and I require water of a little different sort -- FRESH WATER -- also provided by the earth. The KINDS and AMOUNTS of water the earth provides are different from place to place, and from time to time, but ALL LIFE, even desert life which have many interesting ways of getting water, REQUIRE WATER. Return slide one to its place at the front of the box and put slide two in the viewer. (PAUSE)

I took this picture high in the Rocky Mountains. What life requirement do you think is shown here? It is AIR. The air is rather thin, usually cold, and always moving here. The air is also much thinner here than where you live, but some plants and animals have adapted themselves to life at the mountain tops. You and I could live in the thin air, but it would take some "getting used to." Air is found in lakes and oceans, but it is even more scarce in water. Things that live under water still NEED AIR, and have developed various ways of getting needed air. Return slide two and place slide three in the viewer. (PAUSE)

Do you have palm trees living outdoors where you live? A certain TEMPERATURE RANGE, which differs for different living things, is a life requirement condition the earth provides. Such things as polar bears and penquins are adapted to living in the earth's colder regions. Palm trees and monkeys are adapted to more tropical areas. EVERY form of living thing has a TEMPERATURE RANGE for which it is suited. No life can survive in the very low and very high temperatures that are found on most heavenly bodies that we know about, or that are produced in the laboratories of some scientists and engineers. Return slide three and place slide four in the viewer. (PAUSE)

Slide four shows SOIL. You can call it "dirt" if you like. It has another life requirement IN IT. In soil, you can, with careful inspection, find all sorts of things -- things ranging from earth worms and grubs, to decaying plant roots and leaves, to countless tiny things like small insects and even smaller insect eggs. Even more countless millions of microorganisms, including many valuable kinds of molds and bacteria can be found in soil. To get a close look at such things, and at the tiny pieces of clay, silt, and sand of the soil, one must use a microscope or some kind of magnifying glass. To see the LIFE REQUIREMENT material needed by living things, even normal microscopes can't help us much. CHEMICAL DETECTIVE work is used. CHEMICAL ELEMENTS, such as phosphorus, potassium, and nitrogen, are examples of the life requirement I'm talking about. Have you ever been told that calcium is needed for proper growth of your teeth and bones? Calcium, like nitrogen, phosphorus, and many more such CHEMICAL ELEMENTS, are found in the minerals in our soils. These chemical elements are also found as parts of the waters of our earth, and in smaller amounts, in our air. Living things need certain amounts of a number of chemical elements in order to live and grow properly. Return slide four and put slide five in the viewer. (PAUSE)

If you were a squirrel jumping from tree to tree, you wouldn't have much trouble moving through these trees. If you were a long winged bird like a fish hawk, you would have a problem, and you probably wouldn't hunt here. The trees are quite crowded together. They are so crowded that there is little room for many more trees. ENOUGH ROOM -- OR SPACE -- is another living condition required by all living things. The amount of space big enough for one kind of life, may not be big enough for others -- or it may be much MORE SPACE than is needed by yet others. A tiny spider doesn't need much space. But it does need a certain amount. An oak tree requires much more space than does a rose bush. Have you ever seen a fish bowl that had too many fish in it? Fewer fish, or a larger bowl, would have provided more space for each fish, and a healthier life for each fish.

Do YOU need a certain amount of space for yourself? Don't go home and say you've got an argument for tossing brother or sister out of your room! Why is SPACE required by living things? Mostly so that each living thing will be able to get enough of the earth's materials -- such as the WATER, AIR, CHEMICAL ELEMENTS, and OTHER THINGS necessary for healthy living. Yes, there are OTHER THINGS necessary for life. Can you guess what some might be? FOOD and SUNLIGHT are two of them. Return slide five and put slide six in the viewer. (PAUSE)

Food and sunlight provide living things with ENERGY. Scientists have found that ALL LIFE -- PEOPLE TOO -- need energy. All CHANGES that take place in living things require energy. Have you heard it said that you need energy to work and play? You need energy not only to make your muscles move and your brain work for you, but also for smaller and slower changes in your body. It is needed to heal cuts and bruises. It is needed for all the many chemical things that go on inside you to keep you alive and healthy. Energy is needed to grow.

The bullfrog in slide six didn't look like he does here when he was young. He not only grew in size, but he changed in many ways while developing from an egg to a tadpole, to a frog. These changes required a number of things -- one was ENERGY. Return slide six and place slide seven in the viewer. (PAUSE)

Here are two small oak tree seedlings that some fifth grade students planted last fall. Can you save some milk cartons or orange juice cans like those shown here, for planting containers? The students planted acorns, similar to those you can see near the bottom of this picture. While growing from acorns to oak seedlings, these plants needed ENERGY like the frog did. As these young trees grow into large oak trees, they'll need much more energy too. Where do living things like YOU, the frog, and the oak seedlings, get ENERGY for CHANGES? All life gets energy from FOOD.

Some living things, like people, animals, many kinds of microorganisms, and a few kinds of plants bring food into their bodies in one way or another. Some, like people and most animals, move around to get their food. Others, like barnacles, mushrooms, and some microorganisms, stay attached to materials in areas that provide them with food. Return slide seven and place slide eight in the viewer now. (PAUSE)

The cat, shown eating, is taking in FOOD that will give him ENERGY, the chemical elements that will help him use the energy, and body-building protein. FOOD GATHERING, like running and playing, TAKES energy, too.

Things that move about to get food, must be able to get more energy from their food than it takes to find their food. Tame cats, like this one of mine, don't need to use much energy finding food because their food is brought to them. But how about this cat's more wild relatives like the mountain lions and bobcats?

The last slide, number nine, is a picture of a living thing that doesn't move around to get food. Neither does it grow in a food rich area where food can be easily taken into it. Thousands of years ago, GREEN PLANTS like this one, solved the problem of food gathering in a different way. Do you know how? They chemically MAKE their food! Green plants use materials from the earth's AIR and WATER to MAKE FOOD. They use chemical elements from the soil, or if they live in water, from the water, to help them make a variety of different kinds of foods. Like food finding, food making also requires energy. Where do you suppose the ENERGY for food making comes from? Does slide nine give you a clue? Yes -- SUNSHINE. The plants and tiny microorganisms that make their food, use energy from the SUN. The most common way they do it, is to "capture" energy from parts of sunlight, with a green material the plants make.

You may have head someone call this green material -- or green pigment, CHLOROPHYLL. The GREEN COLOR found in most of the plants you are familiar with, is the pigment, chlorophyll. Are you familiar with the plant in slide nine? I would like you to become familiar with it soon. Its not a good friend on mine! This plant is POISON IVY. Its three leaflets help many people recognize it -- and it is a plant to watch out for. Sometimes it is found in thick beds in sunny areas along paths or at the edge of woodlands or fence rows. Sometimes its found in the form of a vine, and sometimes it forms small bushes. In any form, at any time of year, it should be LEFT ALONE. In the autumn poison ivy leaves often turn a lovely orange-red color. We'll take another look at poison ivy in later lessons to be certain that you can recognize it and avoid it in the outdoors.

Now return slide nine and check to see if the slides are in the right order. We're about finished with this lesson, but before we finish I'd like to have you take a look at the pingpong ball earth model in front of you. In the next lesson, we'll learn about HOW and WHY the earth's living conditions change in TIME -- about how they change during each day and each season.

Next time I'll ask you to do some experiments with an earth model much like this one, to help discover why and how living conditions change in time. Do you see the dotted line with the sign saying, "You live somewhere on this line?" We'll use this dotted line alot in the next lesson. There are twenty-four dots on the dotted line. Maybe between now and the next lesson you can guess why I've put 24 rather than 23 or 25 or some other number. By the way, please keep in mind that you don't have to wait for a class field trip to visit the outdoors.

Now its almost time to rewind the tape so that it will be ready for the next person. When I tell you to, please push the STOP botton on the front of the tape recorder. And then you should push the REWIND button. After you push the rewind button, you will hear the sould of the tape rewinding. When the rewinding noise is finished, you should then push the STOP button once more.

Let me repeat the directions, please. When I give you the signal, push the STOP button and then push the REWIND button. After the rewinding noise is finished, you should then push the STOP button again. Goodbye until our next lesson. Push the stop button now and then push the rewind button. (PAUSE) Goodbye.

AUDIO-TAPED SCRIPT, AUTUMN LESSON NUMBER TWO

Hello. How are you today? In the last lesson you learned about some of the materials and conditions that the earth provides for living organisms. Do you remember that all living things - including you and I - need AIR, WATER, ENOUGH SPACE, A CERTAIN TEMPERATURE RANGE, and a number of CHEMICAL ELEMENTS? I imagine that you also remember that all living things need ENERBY too. And that some - mostly animals - get their energy from the food they eat -- and others - the green plants - get their energy from food they MAKE from water and material in the air. These green Plants use sunlight energy to put together carbon dioxide from the air, and water to make their food.

Do you also remember that living conditions and materials aren't the same everywhere on earth? One of the reasons there are so many kinds of living things is that plants, animals, and microorganisms have developed so many different KINDS or SPECIES that there is life of some form just about anywhere you can think of on the surface of the earth, in its oceans, lakes and streams, and even in the soil.

The earth's living materials and conditions, and the living things that use them, are not only different from place to place, but they are different from TIME to TIME. Living things have developed Not only a great number of different body forms and "ways of living" to make use of conditions and materials in different places, but they have developed WAYS OF LIVING and SPECIAL BODY PARTS that help them adjust for the living condition changes that take place IN TIME - DURING THE DIFFERENT SEASONS OF THE YEAR FOR EXAMPLE.

This lesson is about living conditions and materials CHANGING IN TIME, --- WHY these changes take place, AND HOW living things react to these changes.

You and I as people also react to these changes. Take slide one from the slide box. Do you remember how to work the slide viewer? Take a minute and practice with slide one if you think you need to. (PAUSE)

If you have a little brother or young nephew, he might have shed his winter hat and mittens and gone out to fly a kite like the lad in this picture taken one Spring day. The tree in the background didn't have a new set of leaves when this picture was taken, but it wasn't long after when the days were warm enough and the frost was gone -- and growing conditions returned for the tree. Return slide one and put slide two in the viewer.

What season of the year is illustrated by slide two? Yes, it was summer when I took this picture. Not only the days, but the nights too were warm then. So was the ocean water in late summer when these girls were building a castle in the sand. Return slide two and put slide three in the viewer.

The air had taken on a chill and these boys decided it was time for some football practice. Football and soccer playing are Fall behaviors for people. Like kite flying in the Spring, and sand castle building in the warm summer sand, football playing is not a behavior that is absolutely necessary to human life -- we would be able to survive the year without doing these sorts of things, but I don't think we'd enjoy life as much. Return slide three and put slide four in the viewer.

Have you ever done any ice fishing, like the boy in this picture? FISHING isn't a winter behavior, but fishing through the ICE is. This kind of fishing, like skiing, ice hockey, and snow-shoeing, is done in the winter in areas where the earth's conditions make them possible. The boy's "pulled down winter cap" and his mittens are also part of his winter behavior. They, like his winter coat and boots are necessary for his survival while ice-fishing. Now return slide four. We'll get to the remaining slides later in the lesson.

You and I react to the CHANGING living conditions of the seasons. All other life in the temperate and polar parts of the world also change their ways of living with the changing seasons. There are lots of interesting questions about living conditions changing IN TIME. How do the different living things react? How do living things know WHEN to grow differently or to change their ways of doing things? And WHY do living conditions change in time?

I'd like to work on the question "WHY do living conditions change." Let's consider a change that you see happening every day -- the change from day to night.

Find the gold or yellow wooden box under the carrel. Keep your earphones on, push your chair back, and have a seat or kneel on the floor a minute so you can work with this "Earth-Sun"box. The earth-sun box is a model of the earth and the sun. The light bulb sun should be much larger and much much farther from the ping-pong ball earth if the box were a very realistic model, but this model will serve its purpose of helping you to understand WHY we have night and day on earth --- and it will help explain WHY we have seasons - Summer, Fall, Winter, and Spring, here where we live.

Have you gotten yourself comfortable beside the Earth-Sun box? There is a light switch just below the light bulb sun -- turn it on by twisting the switch. Do you see the four yellow-ringed holes and the four white-ringed holes in the bottom of the box? Each pair of holes is labeled with the name of a month. One should say "September", another "December," another, "March," and the fourth, "June." The ping-pong ball earth on the wooden peg - or "dowel" - should be in a hole - any hole will be OK right now. If the light is on you should be able to see that the side of the earth that is close to the light bulb-sun, is bright -- it is illuminated by the sun. On our model, that side of the earth is having "daytime." The other side of the earth should be darker - it won't be real dark because in our box model, some light is reflected off the black wall on to the night side. You may be able to better see the difference between day - the lighted side, and night - the darker side away from the sun - if you put the cardboard lid - yellow side up - on the top of the box and look through the hole above the ping-pong ball earth.

Now take the lid off the box and TURN the earth model around on its axis. The axis, sort of like an axle, is a brass rod on our model. The real axis of the earth is more like an invisible line, through the earth. If you had enough time - a whole day in fact - you could turn the model earth so slowly that one of the dots on the dotted line would take 24 hours to return to the spot where it started. Then the model would be even closer to the real thing.

The dots have been drawn on the ping-pong ball earth model at a latitude that is the same as the latitude of the area you live in. Maybe you can pretend that your school, with you in it, is on, or very close to one of the dots on the dotted line. As you turn the earth, the dot that your school is near, travels through the lighted on day side of the earth and through the dark or night side, just as all the other dots at your latitude do, and just like your school does each day in the real world.

You may have noticed that here are 24 dots on the dotted line. Remember in the last lesson, I suggested that you guess why I put 24 dots. Did you guess? The 24 dots are spaced fairly evenly - the distance between a dot and the next dot is about the same. In the real world it takes very close to 24 hours for the earth to rotate each day on its axis. With a little arithmetic maybe you can figure out about how long it would take a dot to move from a place in space to the place of the next dot. Yes indeed, it would take ONE hour. Twenty-four dots would move completely around the axis in twenty-four hours -- or you could think of it as ONE SPACE PER HOUR. So on our model, each of the 24 spaces between the 24 dots can represent ONE HOUR of the day IN TRAVELING TIME OF THE SURFACE OF THE EARTH AROUND THE EARTH'S AXIS.

We'll do some more with the earth-sun model in just a moment. Turn off the light bulb sun for a minute and get back into your chair. I think you know that the earth not only rotates about its axis once each 24 hours giving us night and day, but that the earth also travels the sun -- much like it is shown traveling in the picture on the bulletin board. Look at the picture showing the sun and the earth in its orbit, in the upper right hand area of the bulletin board. The earth is shown in 10 POSITIONS in this picture. As a viewer of the picture, the earth is closest to you in its Summer, late Summer-early Fall, and Fall positions than it is during the rest of the year. The picture is a kind of model like the earth-sun box -- and as a model it too isn't very close to reality. The distances and sizes shown are not at all accurate -- space doesn't allow correct sizes and distances -- but still the picture can be used to help explain WHY certain living conditions CHANGE IN TIME.

The words "Fall, Winter, Spring, and Summer," are written on the picture to help tell you that it takes ONE YEAR with its four seasons for the earth to travel -- that is, revolve, around the sun. Let's now consider WHY these four seasons occur each year. You and I, and all outdoor living things in this area REACT to these seasons with their variety of living conditions.

Have you noticed the RIDDLE PICTURE which asks, "What is it?" Before the end of this lesson, you should be able to answer the riddle.

Now let's go back to the earth-sun box model on the floor. Move the ping-pong ball earth model to the YELLOW HOLE MARKED "SEPTEMBER". Have you found the SEPTEMBER hole? Put the dowel end of the earth model in the YELLOW hole, not the white hole. With the light bulb turned on, look straight down, through the cardboard lid, at the top of the earth model. Can you see the latitude line of DOTS? They should look like a "RING" of dots to you while you are looking down from above the North Pole.

REMEMBER THAT A SPACE BETWEEN ANY TWO DOTS REPRESENTS ONE HOUR. COUNT the spaces that are in daylight -- this will tell you how many hours of daylight you have where you live on one day in September. Count the spaces from where the shadow crosses the dot line on one side of the earth - to where the shadow crosses the dot line on the other side. Did you count about 12 spaces? You probably didn't get exactly 12 spaces - that is, a DAYLENGTH OF 12 hours. Counting is made a little difficult because of the "TWILIGHT" zone of dawn and evening twilight. Twilight is real - so in this respect, our model is fairly accurate. There is a day in late September each year, when we have exactly 12 hours of daylight and 12 hours of darkness. Do we have 12 hours of daylight and 12 hours of darkness EACH DAY of the year?

Lets find out. If you're done counting on the September yellow hole move the earth from the September yellow hole - a time of late summer and early fall - to the DECEMBER YELLOW hole. Look through the lid hole directly above the December earth position and again COUNT the SPACES that are in the "sunlight". Did you get about NINE spaces this time? If the model were exactly correct you would have gotten between

NINE and TEN hours of daylight in the YELLOW December hole. That's FEWER hours of daylight that you found for September, isn't it? Count it again if you like. Yes, as you can probably remember, there are fewer hours of daylight in the late fall and early winter as in December - than there were in late summer and early fall -- in September. I imagine that you often hop out of bed before the sun rises in December, and don't have much time to play outdoors in daylight after school. The sun rises later and sets much earlier in December, than it did in September.

Have you noticed that the YELLOW September hole and the YELLOW December hole are both "tilted", or "slanted?" Place the earth model dowel in the September and then the December Yellow holes again. Did you find that the yellow holes are all slanted in the same direction? Place the earth model dowel in the March Yellow and then in the June Yellow holes too. Dis you find that ALL the yellow holes are slanted in the same direction? The slanted holes in our model caused the axis of the model earth to be tilted didn't it? Let's go on, and figure out what the slanted yellow holes and tilted earth axis means to living things on the earth.

Put the earth model in the March yellow hole and count the number of hours of daylight on a late March day. (PAUSE) Did you find about 12 hours of daylight for the yellow March position? There IS a day in late March when we get exactly 12 hours of daylight and 12 hours of darkness. Try the earth model in the WHITE March hole too. (PAUSE) You should find about 12 hours of darkness in the "straight-up" or "90 degree" white March position, too. In fact, why don't you try the model in ALL FOUR "STRAIGHT UP AND DOWN" WHITE holes. Turn the tape recorder off for a minute if you like, by pushing the RED STOP button, while you move the earth model to each of the other WHITE HOLE positions, and count the number of daylight hours the earth would get IF the earth's axis were "straight up and down" as the white holes are. Turn the tape recorder back on by pushing the GREEN PLAY or NUMBER ONE button when you are done experimenting. Take a minute or two. (PAUSE)

Did you find that you got about the same number of hours of daylight and darkness in each of the white hole positions? If our model is accurate, you should have found ABOUT 12 hours of daylight and ABOUT 12 hours of nighttime, each day, throughout the year -- IF THE EARTH'S AXIS POINTED STRAIGHT UP -- OR WAS AT 90 DEGREES TO THE PLANE OF THE ORBIT OF THE EARTH we would have 12 hours of daylight and 12 hours of night each day.

The white holes DO NOT GIVE US A GOOD MODEL of earth positions -- the YELLOW holes, however, do give us a more correct model of the earth positions around the sun. Using THE YELLOW HOLES, the earth model's axis is tilted at 66½ degrees from the plane of the earth's orbit and this is much closer to what we know to be true about the positions of the earth in its orbit. In the real world, the NORTH end of the earth's axis, which is often referred to as the NORTH POLE, points toward a star we call the North Star. The north pole points at the distant North Star all year -- as the earth revolves around the sun. SO PUTTING THE

EARTH MODEL IN THE YELLOW HOLES GIVES A MORE ACCURATE PICTURE OF THE EARTH POSITIONS BECAUSE THE YELLOW HOLES ARE ALL TILTED AT ABOUT THE RIGHT ANGLE AND IN THE SAME DIRECTION and this tilts the model earth's AXIS at about the right angle and always in the same direction - much like the axis of the real earth.

Let's use the earth-sun model box once more. Remember that there were about 12 hours of daylight in both the late summer-early fall and the late winter-early spring positions -- in September and in March. And you found about only 9 or 10 hours of daylight in the December, late fall-early winter position. About how many hours of daylight do we get at this latitude in the June position? This is the time when Spring is ending and Summer is beginning. Put the earth model in the YELLOW June hole and count the spaces at our latitude. Did you get about 15 hours of sunlight and 24 minus 15, or about 9 hours of darkness? Before you leave the earth-sun model, notice that during ALL seasons of the year, the earth is fairly close to the SAME distance from the sun! No, the earth ISN'T closer to the sun in the summer! Turn off the model sun light bulb by turning or twisting the switch under the light bulb. Then put the lid back on the box and push it under the carrel for the next person to use. We're going to use the bulletin board pictures and a little later, I'll ask you to use the last two colored slides.

Have you turned off the model sun and put the box away? Good. Now look at Picture A on the right side of the bulletin board. This is a model view, looking down on the North end of the earth's axis - the North Pole that is, -- in late December or early January. Can you see that at this time, a person standing near the North pole, would have darkness or nighttime all day, as the earth rotated on its axis? In this picture, the dotted line is drawn at our latitude - which is about 42 degrees North Latitude. There is no twilight zone of sunrise and sunset in Picture A, it's not quite as realistic as the box model, but the spaces are a little easier to count. Here you can see, as you saw on the ping-pong ball model, we have a little more than 9 hours of daylight during early winter.

Now look at the chart to the left of Picture A. It is called "Daylength Change Where You Live", If you look at the DECEMBER 15TH DATE - the bottom line on the chart, you will see that where you live the sun will rise at 7:27 Eastern Standard Time in the morning. The next column shows that the sun will set at 4:36 Eastern Standard Time - that is 36 minutes after 4 o'clock in the after noon on December 15. The fourth column shows that the time between sunrise and sunset - that is, DAYTIME, a "day length", will be 9 hours and 9 minutes long on that day in late fall. This day length of 9 hours and 9 minutes, is not quite as much daylight as is shown on the WINTER day picture A.

Column 5 in the "Daylength Change Where You Live" chart compares the amount of daylight hours - shown in yellow, and the amount of nighttime hours - shown in gray, for each of the 12 days that are shown on the chart.

Slowly run your finger down Column 5 on the chart starting at the top, until you come to a place where you find about the same amount of yellow - or daytime - as you do gray - or nighttime. Did you stop on the March 15 line? You can see that from January 15th to March 15th, our nights are longer than our days, but our days are getting longer. There is a day in late March - we call it the first day of Spring - when we get 12 hours of daylight and 12 hours of darkness. From the first day of Spring in late March until the first day of Summer - in late June - we get more daylight each day than night. Can you see this in Column 5 on the chart?

On June 15, we get 15 hours and 13 minutes of daylight. That's alot of daytime for outdoor fun. Look to the bottom right on the bulletin board for a moment. Can you find Picture B? Here is a view looking down on the North Pole end of the earth's axis - notice its tilt in this picture too. About how many hoursof daylight does the 42 degree North latitude dotted line tell us we have in Picture B? Did you count 15 plus a little bit more? Picture B is supposed to be a picture model of how the earth would look from outer space above the North Pole on about June 30th in very early summer. Now look back at the "Daylength Change" chart to the left again.

If you'll look on down the chart in Column 5 from June, you'll see that the days through the summer get shorter and shorter -- and they continue to get shorter, a little less daylength each day, until you reach the bottom of the chart again. The first day of winter, in late December, isn't shown. But on that date, about December 21st, we have our smallest daylength -- or "shortest day" of the year.

So now you know that our daylength - our amount of daylight in a day - changes every day throughout the year. I have a hunch that you know that before you began this lesson. But did you know WHY the sun comes up and sets at different times from one day to the next? Do you know WHY now? Think about the tilted or slanted holes in the earth-sun model. Remember how the earth's axis was tilted - always tilted the same amount and in the same direction toward the North Star, each day of the year? Now you can tell why daylength changes -----because of the constant or fixed tilt of the earth's axis as the earth revolves around the sun each year. Can you answer the riddle question now?

You could think of the "Variety" in the riddle as the variation or change in daylength. But the "Variety" could also be thought of as the variety we have in our different SEASONS of the year too! How do you think of our SEASONS? Many people describe Winter as "cold", Summer as the "hot" season, and Spring and Fall as sort of "in between", either going from hot to cold as in the Fall, or going from cold to hot. Let's look at colored slide number five. Put slide five in the viewer. If you wanted to heat the water in the copper kettle you could put it on a lighted burner on the stove. If you left the kettle on for only two minutes, the water wouldn't get nearly as warm as it would if you left the kettle on the burner for ten minutes. What do you suppose this picture has to do with daylength and heating the earth? When we heat water only a short time, it takes some time for the heat energy to warm the water. When we heat water for a longer period of time the water gets much warmer -- and even stays warmer longer after the kettle has been taken off the burner. In much the same way, when the sun shines on our area for a short time each day, as it does in late fall and early winter, the earth's surface loses more heat energy at night that it gains in the daytime. But in late spring and summer, when the daylength is much greater, the earth's surface gains more heat during the daytime than it loses at night -- and we have much warmer weather. The heating of the earth's surface, most of the surface being oceans as you know, is like the heating of a kettle of water in some ways. Once a kettle full of water is hot, it takes some time for the water to become cool again. The surface of the earth, heated by sunlight energy, is much the same. One might think that our coldest weather would be on or around the first day of winter -- our day with the shortest daylength. But this is not the case. As you know, our coldest weather comes later in the winter while the days are still quite short, but not quite as short as the first day of winter. Like a kettle of hot water, the surface of the earth requires some time to cool down. Likewise, the first day of summer in late June, is seldom our warmest day of the year. The surface of the earth also requires some time to warm up after the short days of winter and early spring.

Return slide five and put slide six, the last slide, in the viewer. Length of daytime is not the only thing that determines how much sun energy is available to heat the earth's surface. Slide six, showing two girls sunbathing on a summer day, will help explain another thing that is important in the heating of the earth's surface.

The forehead of one of these two girls is much more likely to get a good tan -- or sunburn -- than is the forehead of the other girl. Which one, the girl in the chair, or the girl on the ground, is most likely to get a tanned forehead? You were right if you said that the girl in chair is most likely. The sun is hitting her forehead directly -- or at a high angle. But the sun is falling on the girl on the ground at a low angle, a sort of a "glancing" angle, because of her position. The earth's surface where you live receives light at different angles during the different SEASONS of the year, too. Do you remember that the sun was fairly high in the sky at noon on summer days not many months ago? If you keep a check on the noon position of the sun as winter approaches, you'll find that the sun doesn't appear as high at the top of its path across the sky. For kids in Alaska, the sun will soon barely rise above the horizon, before it sets again, and the sunlight will strike their cities and schools at a very low angle at this time of the year. When the sun strikes the earth at a low angle, as it does just after sunrise and just before sunset every day of the year, the shadows that are cast, are very long. You might want to devise an experiment using the shadow of a long stick or possibly of your school flag pole, to watch how the angle of the sun's rays changes each day as winter approaches.

Remember to observe the length of the shadow at the same time each day so that you can compare the sunlight angle from one day to the next. Return slide six and check to see if the slides are in order. We're about finished with this lesson. Now you should know more about WHY we have day and night, and why we have seasons where you live.

Do you have an answer for the riddle now? What is tilted that causes our changes in daylength and changes in the angle that the sun's rays strike the earth where you live? What is it that causes the Variety of Seasons in this part of the world? I imagine that you discovered some time earlier in the lesson, if you didn't already know it, that it is the AXIS of the earth that is tilted.

In the next lesson we'll consider how plants and animals know when seasons are changing --- how they "tell the future" - with no crystal ball - by detecting changes in daylength. We'll use quite a few slides taken outdoors, and some books, to show HOW some plants and animals react to changing seasons.

Now its time to rewind the tape so that it will be ready for the next person. Do you remember how you did it for lesson one? When I tell you to, please push the red STOP button and then push the YELLOW REWIND BUTTON on the tape recorder. After you push the rewind button, you will hear the sound of the tape rewinding. When the rewinding noise is finished, you should push the stop button once more. Please be certain that the lights are off in the earth-sun box and slide viewer before you leave.

Please push the Red Stop button now and then push the Yellow Rewind button. Goodbye, until our next lesson.

AUDIO-TAPED SCRIPT, AUTUMN LESSON NUMBER THREE

Hello.. How are you today? I hope your're having a good day. Have you taken any outdoor field trips, hikes, hunting or fishing trips lately? Your class field trip should take place in about three weeks or sooner. But don't forget that you can have a good time on outdoor trips with your family and friends most anytime.

In lesson one we considered the idea that living things need certain materials and living conditions that the earth provides, and I talked about HOW these materials and conditions are different from place to place. In lesson two we considered how living conditions change from TIME to TIME, and what CAUSES daily and seasonal changes in DAYLENGTH. Do you remember how important the constant tilt of the earth's axis is, in helping to cause changes in daylength throughout the year? The constant tilt of the axis toward the North Star while the earth spins and revolves causes us to have a long daylength of fairly direct sunlight in late Spring and early Summer. And the same tilt, while the earth is traveling around the other side of the earth in late Fall and early Winter results in short days and low angle sunlight in the northern half of the world. We can detect the change in angle of the sunlight during the different seasons by watching how the daily path of the sun changes as it crosses the sky. The shadows made by objects on the surface of the earth can be used to watch this change from day to day.

Do you also remember how the DELAY in the cooling of the earth's surface causes us to have our coldest weather in late Winter, a number of weeks after we had our shortest day? Its a good thing the earth does require TIME to warm up and cool down. Many living things can't adjust themselves to rapid changes in temperature. They need, and take TIME TO PREPARE for seasonal changes.

We are NOW in a time of fairly fast change of living conditions and materials available for living things. But living organisms have been PREPARING for these changes for many, many weeks. Most of them started last Summer, long before the weather gave them any hint or clue of Winter's approach.

In this lesson I'll talk about (one) the living condition changes that are taking place now as Winter draws closer, (two) HOW some living things in this area CHANGE their ways of living so that they - or their young - can survive the living condition changes, and (three) HOW plants and animals sort of "Set Their Clocks" so that they do things at the right time to match their ways of living to the changing conditions. That's quite a bit to consider for one lesson, so I'll continue some of these ideas in the next and final Fall lesson.

Have you seen any slow moving wasps or flies on a cold Fall morning lately? These so called "cold-blooded" animals don't do much buzzing around outdoors on Fall days until late in the morning when the air temperature has risen. Birds and mammals, the "warm-blooded" animals, are affected by the colder weather too but they have a couple of things going for them. First, since they can control their inside (or Body) temperature much more effectively than other animals, the birds and mammals aren't affected the same way by cold Fall mornings. Birds and mammals can generate a little extra heat on the cold mornings. But as nights, mornings, and afternoons become, and remain, cold, even birds and mammals change their WAYS OF LIVING.

Find the plastic "library book box" in front of you, and take out the MAMMAL book. It has a picture of a white-tail deer on the front cover.

Turn to page 43 in the MAMMAL book. On page 43 you will find a picture of some MINK. Mink remain active around here all year. You may know someone who traps mink during the trapping season in the Fall and Winter. Mink have a thick coat of fur at this time of the year. Their Winter fur helps them conserve their needed body heat during the cold weather when heat energy is easily lost to the cold air. Mink don't get their Winter coat out of storage in a closet, when the chill of Fall weather comes -- like you and I might. Mink, like other active Winter mammals start growing their short dense Winter "under fur" while the weather is still warm -- in very late Summer or early Fall, long before the weather can give them any hint that winter is coming. Neither do they have a calendar or wrist watch to look at, like the frog and duck are doing in the bulletin board cartoon. But scientists have found that mammals - and most all other living things - DO HAVE a timing device that starts them doing things early, in preparation for seasonal changes in living conditions. Scientists call this timing device a BIOLOGICAL CLOCK. We don't know yet exactly how plants' and animals' BIOLOGICAL CLOCKS work, but we do know quite a few things about the clocks. We know the biological clocks are CHEMICAL THINGS -- that is, the clocks aren't spring wound and they don't tick or hum or give loud ringing alarms like an alarm clock does to get you up in the morning. CHEMICAL ALARMS that cause changes in WAYS OF GROWING, or CHANGES IN WAYS OF DOING THINGS are given - and HAVE BEEN DETECTED by scientists in many plants and animals. A sort of chemical alarm helps bring about the slow growth and development of the mink's Winter undercoat - a sort of heavy dense Winter underwear! It is this dense fur that makes the mink fur very valuable to fur coat makers. Turn to page 110 in the MAMMAL book. On page 110, a muskrat is shown eating a root-like part of a cattail plant. The thick cold-weather fur of muckrats is also sought by trappers in the Fall and Winter. And like the fur of mink, fox, and other active Winter mammals, some people use the fur of muskrats to help themselves keep from rapidly loosing their body heat, during cold weather.

Scientists have much yet to learn about the chemical workings of biological clocks, but they have discovered the way that plants and animals SET their biological clocks, so that needed changes take place at about the RIGHT TIMES during the year. Turn back in the MAMMAL book to page 40 and look at the weasel, while I talk a little more about how biological clocks are SET. On page 40 you can see two "Color Phases" of one kind of weasel. This short-tailed weasel is called an ERMINE in the Winter. It has a Summer name and a Winter name because for a long time, many people didn't realize that the brownish short-tailed weasel and the white ermine were the same animal. I wonder how many kings who wore ermine fur on their robes in ancient times, knew this? The weasel like the snow-shoe rabbit or VARYING HARE, shown on page 118, get entirely new Winter coats. Their white coats are not simply brown fur turned white. Most of the brown hairs of their Summer coats fall out a few at a time before Winter weather is near, and are replaced by both dense white underfur AND white longer outer fur, or "guard hairs." Scientists did experiments on animals such as the weasels shown on pages 40 and 41, and the varying hare shown on page 118, to find out WHAT SETS their biological clocks. It was found for example, that exposing caged weasels to EXTRA HOURS OF LIGHT each day - that is, longer than normal daylength during the late Summer and early Autumn, prevented the weasels from developing their Winter white fur! It was found that SOMEHOW, the weasels could tell when the days were getting shorter -- when daylength was changing! And they didn't grow white fur until the day reached a certain rather short length. Many other experiments were also done with many other plants and animals to see if other things, such as cold weather, or the activity of other living things, would SET their biological clocks. But scientists kept finding that the AMOUNT of daylight and darkness, that is - DAYLENGTH is the CLUE that both plants and animals of many, many kinds of plants and animals USE TO SET their biological clocks!.

Turn to page 84 in the MAMMAL book. On page 84 are several species of the gray squirrel. The hustling, bustling food gathering activity of gray squirrels in the Fall, like their development of Winter fur, is also STARTED by their biological clocks which are set by the shortening daylength of late Summer and Fall. Not only are a dense Winter coat and white camouflage coloring helpful for Winter survival, but a thick layer of fat and a bunch of stored food are also helpful.

Can you find the photograph of a chipmunk eating corn on the middle right-hand side of the bulletin board? Various kinds of chipmunks are shown in the MAMMAL book on pages 78 through 80. The one in the photograph is the Eastern Chipmunk. This chipmunk sleeps much of the Winter in an underground den, close to a supply of stored seeds, nuts, berries, mushrooms, and other food materials it collects in the autumn. Although many Eastern Chipmunks go into a very deep sleep through much of the Winter, they don't truly hibernate as some books will tell you they do. Many Eastern Chipmunks will rise from their sleep at various times during the Winter and eat some of the food stored nearby in their den. In the autumn, the shortening days set their biological clocks, and the clocks in turn chemically "tell" the chipmunks to actively eat and collect food. Their increased eating results in the building up of a layer of insulating fat under their skin before severely cold weather comes. When the cold weather does come, they are ready to "hole up" for most or all of the Winter.

What about animals such as the frog and the duck shown in the cartoon on the bulletin board? How do they change their ways of living to help their chances of survival during changing living conditions?

Return the MAMMAL book and take the REPTILES AND AMPHIBIANS book from the library box. The REPTILES AND AMPHIBIANS book aas pictures of a frog, a turtle, a lizard, and some salamanders on its front cover.

Many of these cold-blooded animals live in areas closer to the earth's equator in more tropical areas, where seasonal changes in living conditions are not as severe as they are here in the north temperate region, but we do have quite a variety of frogs, toads, salamanders, snakes and turtles in this area. Although I'm certain you've seen some of these cold-blood animals moving about on warm autumn afternoons, it won't be long before you'll see them no more until Spring.

On page 17 there is a picture of a turtle and a snake hibernating. Their biological clocks help get them chemically "ready" for Winter hibernation. Hibernation is not quite the same as the deep sleep that a chipmunk goes through in the Wintertime. It is very difficult to detect ANY life in a hibernating animal, because their body processes work and move SO SLOWLY that it appears that the animal isn't alive at all.

Have you ever seen a large number of snakes moving into a rocky area in the fall? Most snakes, turtles, frogs, and toads in this area will be "holed up" before the temperature is so low that they can not get to their winter homes. Some of the frogs seem to wait until it gets quite cold before they hibernate underground or in the mud at the bottom of ponds. On page 38 is shown a Box Turtle. This is a PROTECTED species in your area, and is not to be taken home for a pet. On the next page, page 39, the book tells that young box turtles, which hatch in early fall, may hibernate soon after hatching -- and BEFORE they have eaten anything!

Return the REPTILES AND AMPHIBIANS BOOK NOW AND take the book titled, "BIRDS" Did you know that there is another set of books in your science classroom that includes the same books you have in the carrel? Please leave these books in the carrel when you are finished with this lesson. If you want to look further at some of them, ask your science teacher if you may use those in your classroom, or others about different animals and plants from the same series that are also found in your classroom. What do many birds do as living conditions change with the changing seasons? If you turn to pages 128, 129, and 130 near the back of the bird book you will find an answer. Even though many birds develop a heavy layer of fat under their skin in the Fall, and others, especially waterfowl such as ducks and geese, have a lovely set of "down" underwear, most birds MIGRATE, that is TRAVEL, to areas where FOOD is more abundant and living conditions are more comfortable for them during the Winter months. If you like, you may take a few minutes to read pages 128, 129, and 130. Don't take more than a few minutes please and remember to push the PLAY button when you are ready for the rest of the lesson. (PAUSE)

SINCE this BIRD book was written a number of years ago, scientists have learned MUCH MORE about bird migration. Most scientists who have studied MIGRATION, agree that FOOD supply -- or rather NOT having ENOUGH FOOD of the right type in an area -- is the main reason WHY birds migrate with the changing seasons. Scientists also now know that CHANGING DAY - LENGTH IS the clue that gets birds started on their migrations. Changing daylength in both the Spring and Fall sets their biological clocks , and chemical things happen inside the birds that gets thm on their way. For some kinds of water fowl, a blizzard or other severe weather sometimes is the clue that gets them going on the last leg of their journeys. Migration is not a behavior that only BIRDS do. Some insects, such as the Monarch butterfly and mammals, such as the woodland caribou and reindeer also migrate during the Spring and Fall.

Return the BIRD book to the box library so you can start using the slides and colored photographs on the bulleting board. The question on the bulletin board, "WHERE HAVE ALL THE FLOWERS GONE?" is not only a good song title, but is a good QUESTION to be asked at this time of the year. Plants, like animals and people also change their ways of living to adjust to changing living conditions during the year. If you go on a field trip tomorrow, I'm certain that you will be able to find some flowers -- I've even found some under the snow while hiking in some areas in late Fall, Winter, and early Spring. In this area, you can still find a few flowers of the New England Aster like those shown in the photograph on the middle left-hand side of the bulletin board. The petal-like flower parts you can find will probably be a darker blue or purple color than those shown here, but you might find some as pale as those in the photograph.

The chances are even better that on a field trip at this time of the year, you'll see many more FRUITS and SEEDS than you will flowers. Did you recognize the pod-like fruit and parachute-like seeds of the MILKWEED PLANT in the photograph below the New England Aster picture? Have you ever taken some of these seeds and let the wind blow them across the land?

Can you recognize the plant shown in the middle photo at the bottom of the bulletin board? The bright orange-red berries of the "bitter-sweet" plant are used by some people to make lovely Fall plant arrangements or Fall table decorations in their homes. But the bitter-sweet plant is becoming very RARE in our outdoors, and you and I shouldn't pick any of it unless we find it growing in fairly large amounts on our own property or on the property of someone who has given us permission to pick it!

If you go on a field trip along a shrubby fence-row or in a hardwood woodlot at this time of the year you might collect the one-seeded fruits of the Avens plant, shown in the photo in the lower right-hand corner of the bulletin board. You may not WANT to collect these tiny hooked fruits but if you brush the plant as you pass by, the chances are excellent that you WILL collect some. Can you see the tiny hooks at the ends of the thin needle-like things in this enlarged photograph of clusters of Avens fruit? This buttercup-like plant, closely related to wild strawberries, had flowers last Spring and early Summer. The plant lives ONLY ONE growing season and it doesn't really adjust to changing living conditions. It dies in the autumn. But long before the growing season ends, the Avens prepares for the next growing season by producing many one-seeded fruits -- and more Avens plants will grow from the seeds on the fruits and produce more seeds and fruits next year.

Death is certainly not the only response of plants to changing living conditions. Many, many kinds of plants live through the winter months, and all such plants in the temperate areas and the polar areas, DO CHANGE THEIR WAYS OF DOING THINGS with the changing seasons. To help such plants survive difficult living conditions many different kind of changes take place in plants. You know that the leaves of many plants change color -- and that the leaves of most of these kinds of plants also fall on the ground during late Fall and Winter. The leaf SCARS, left on twigs or branches after the leaves fall can be easily seen and studied at this time of year. We'll take a look at some of these SCARS in the next lesson, and they may help you discover how the loosing of leaves in the autumn HELPS THE TREES AND SHRUBS SURVIVE the living conditions of Winter. Have you ever had a SCAR develop in you, where you lost a bit of skin? I think you'll find leaf scars more interesting that the scars you might get from a skinned knee or scraped elbow.

For the remainder of this lesson, I'd like to talk about one type of plant response to changing conditions that is found in many plants -- plants of both the kinds that die in the autumn and the kinds that continue to live for other growing seasons. Take slide number one from the slide box and put it into the slide viewer. Do you know the name of this Fall flowering plant? These are common in old field and along our roadsides. The color of its flowers may give you a clue. You were right if you said, "Golden-rod." You may still find some of these plants in blossom if you take a field trip in the near future. Most Fall flowering plants, like the New England Aster and the Goldenrod, are members of a group of plants that scientists call the "SHORT DAY PLANTS." They don't develop flowers during the Spring or Summer months -- times when the days are quite long and the nights are short. SHORT DAY plants need a LONG growing season before they can produce flowers and the shortening days of late Summer and early Fall, SET their biological clocks so that SHORT DAY plants develop flowers in early and middle Fall. SHORT DAY, Fall flowering plants are able to develop fruits and seeds from their flowers rather rapidly. Return slide one and put slide two in the viewer.

The chances are pretty good that most goldenrod plants that grow near here, now look more like the one shown in slide two. The golden-yellow petal-like parts of the flowers had dried and fallen before I took this picture. If you had bumped the plant in slide two, the whitish material -- the tiny parachuted one-seeded fruits -- would have been sent flying in the wind. Return slide two and put slide three in the viewer.

The flowers shown here looked like this NOT in the Fall, but during late Summer. These are clusters of flowers of the common milkweed plant. The milkweed is also a SHORT DAY plant, but its biological clock gets SET during days that are not quite as short as those needed to set the clocks of the goldenrods and asters which bloom later in the Fall. Remember the color photo of the milkweed fruit -- often called a pod. Its on the lower left side of the bulletin board. You won't find any milkweed flowers outdoors now, but milkweed pods and seeds are common along roadsides and in fields now.

Return slide three and put slide four in the viewer. What kind of flowering plant is shown here? Yes, indeed, the young lady has a sunflower in bloom. She grew this and others like it from a few seeds she saved from a Winter supply of bird feeder sunflower seeds. The biological clock of this plant causes it to start flowering earlier that the goldenrod too, because sunflower seeds require more time to ripen and mature than goldenrod seeds do.

Return slide four and put slide five in the viewer. Slide five shows the tops of two of the young lady's sunflower plants - as they looked the following autumn. She ended up with many, many sunflower seeds. Sunflower seeds are easy to plant, fun to watch growing, and not bad to eat either -- if you have some that don't have bug poison or fungus poison all over them. Return slide five and put slide six in the viewer please.

Do you know what kind of flower is shown here? I won't tell you because I'm sure you'll know it when you look at the fruit it develops into -- shown in slide seven. But I will tell you that this is NOT a SHORT DAY plant flower. This flower develops in the Spring, when days are long. Return Slide six and put slide seven in the viewer.

I knew you could recognize apples -- the fruit of the apple tree. The apple flower -- or apple blossom as it is often called -- develops in the spring. Through the warm summer months, a part of the apple blossom and a part of the stem material next to the blossom, grow and develop into an apple. There was an apple blossom for each of the apples shown in this slide -- and they were probably more blossoms that didn't grow for one of a number of reasons. Return slide seven and put slide eight in the viewer.

Here is a view of a sliced -- or cut in half, apple blossom. The slice was made through the middle of the blossom and it was made not long after the apple flower's petals had fallen off. Can you see the small white apple seeds in this picture? The tiny growing apple was smaller than the end of your little finger when this picture was taken. It takes quite a long time for a tiny apple like the one shown to grow and ripen into a mature apple. The biological clock of apple trees sets the time for flower development in the spring when days are long. This allows enough time for the apple fruit to grow and ripen from the apple blossom before late fall weather comes. Apple trees are a member of a group of plants that scientists call "LONG DAY" plants. Long day plants produce flowers only after they have had a certain number of fairly long days. Almost all of the spring flowering plants belong to this group of long day plants. Their biological clocks can chemically tell when days are growing longer and when day length gets long enough that there is little chance a frost will occur and kill their delicate flowers, they develop flowers. Many of the LONG DAY plants are like the apple trees, in that their fruit require a long growing season before the fruit becomes ripe. Return slide eight and put slide nine in the viewer now.

These two views of the inside of apples were taken in the autumn when the apples were fully developed. Can you see the apple seeds in these two different views? One slice, the top one, was made in the same manner as the slice through the apple flower in the last slide. Now the seeds are no longer so small, and they are no longer white in color. The fruit material, the core, and the juicy tissue around the seeds have also changed. Now the apple is ready for its "job." What is the "job" or purpose of fruits such as apples? Let's return slide nine and put slide ten in the viewer.

In slide ten you can see an apple and some other fruit from different plants. Do you recognize the other fruit? You might call the cucumber and the tomato, "vegetables" rather than fruit. But to the scientist, both the tomato and the cucumber are FRUITS. They each developed from a part of the flower of each of the plants, and they each have inside them, the SEEDS of the plant. This is what a fruit is -- a structure that develops from a part of the flower and has the seeds inside it.

The grapes shown in slide ten don't have seeds in them though -- but they are still fruit. They are special grapes, not like those found growing in the wild. These grapes come from plants that have been especially developed so that you don't have to spit out the seeds when you eat the fruit of these seedless grapes. Return slide ten and put slide number eleven in the viewer for a moment. In slide eleven you can see the seeds inside the cucumber and tomato fruit slides. Return slide eleven and put slide twelve in the viewer now. (PAUSE)

Slide twelve shows the apple-like fruit of a thorny plant that is closely related to apple trees. Shown here is the fruit of the wild rose. Like the apple fruit, the fruit of wild rose is now ready for its "JOB". We haven't answered that question yet, have we. You know that the job -- or purpose of SEEDS IS to reproduce the kind of plant from which they come. But what about the job of the fruits?

Could you guess from the photos of the Avens fruit that collects on your clothing in the Fall? Juicy, edible fruits like the apple, wild rose, mountain ash, choke cherries, wild plum, and many, many more, are collected to be eaten by animals preparing for Winter. Quite often the animals don't get a chance to finish a meal, before they are disturbed and the fruit is carried away to a different place. Sometimes the fruit is carried away and only partly eaten, and sometimes even though the seeds are eaten with the fruit by animals, the protective seed coat around the seeds keeps them from being digested and the seeds are carried about and deposited in a place often far from where they grew. Squirrels are notorious for depositing acorns where later on oak trees grow from them.

Put the last slide, slide 13 in the viewer. SPACE of a kind needed by each type of living organisms, was one of the life requirements we talked about in lesson one. Seed "dispersal" or you could call it seed TRANSPORTING or MOVING, helps provide enough SPACE for the seeds to grow in and the new plants to live in. The job of many fruits seems to be to help the seed or seeds inside them get a ride to new SPACE, to places where they can grow. How do the tiny one-seeded cattail fruits get to places where the cattail seeds might grow?

Return this slide and rewind the tape recorder for the next person. Goodbye until our next lesson.

ADDIO-TAPED SCRIPT, AUTUMN LESSON NUMBER FOUR

Hello. How are you today? This is the final lesson of our autumn series of environmental education lessons. In the first lesson I talked about how all living things -- plants, animals, microorganisms, and people were much alike in the things that they need to stay alive and healthy. Then we considered the idea that the earth has the things that living things need to stay alive and healthy, but that these needed materials and conditions are not found in the same amounts everywhere on earth. We then considered how needed living materials and conditions change in time, and what causes some of these changes -- what causes seasons and what causes us to have day and night. In the last lesson, I talked about some of the ways that living things change THEMSELVES so that they are able to adjust the seasonal changes in living conditions and materials. In these Fall lessons, I've talked mostly about changes that are taking place NOW -- in the Fall. Living things change their ways of living and their body parts, THROUGHOUT the year -- not just in the Summer and Fall. I've talked about Fall changes in living things, because you can go outside now --- in the Fall --- and see some of these changes. During the Fall you can also see changes that living things have made in preparation for next SPRING with its warmer weather and better growing conditions. In this lesson and on our field trip, I'll ask you to look for some things that show how living things have prepared for Winter and how some have already BEGUN TO PREPARE THEMSELVES for the growing conditions of next Spring.

In the last lesson you found that MIGRATION is a way that some animals adjust to changing seasons. Migration occurs at a time when the young animals have grown large and strong enough to travel. Migration also brings together many, many, individual animals that spent the late Spring and Summer separated from each other in small family groups. The autumn waterfowl migration time is the time that ducks, geese, and other waterfowl GATHER together in large flocks in the Arctic area and parts of Canada. They travel through this area, stopping only to rest and feed, and remain only as long as the weather is not too uncomfortable for them and food can be found.

Do you see the photograph of the black duck, the shotgun, and hunting coat, on the bulletin board? This duck was one of a large flock of migrating black ducks, taken in an area where man has been hunting waterfowl during migration time for many, many years. For thousands of years, since the time of early man, people have noticed the flocks of waterfowl during the Spring and Fall and have hunted them at those times. But it has been only in recent years that we have learned WHERE they come from, WHERE they are going, and WHAT CAUSES them to migrate. Today they can be hunted only for a short time in the autumn, and taken only in small amounts, because we know from experience that we can kill too many and leave none for future generations to enjoy. We also know that we must stop destroying the wet lands -- the marshes and swampy areas that waterfowl need for nesting in the Spring and Summer or we can drive the ducks and geese to extinction even faster than we can with overhunting.

Put slide number one in the viewer now. The partly plucked (or picked) mallard duck in this picture was migrating when a hunter brought him down for the dinner table. I told about how some animals develop warm "underwear" in the last lesson. Can you see this drake mallard's underwear of "down" in this photograph? The feathers and almost all the down had been plucked from the front of the duck's underside when I took this picture. But only the feathers were plucked from the duck's lower right side -- and you can see the down -- a sort of soft underwear that helps ducks and other waterfowl keep from loosing body heat to icy water in which they often swim. Because this duck spends MUCH of his time feeding in cool or cold water all year round, his down is not produced just for Winter protection. But his colorful outer feathers -- such as his bright green head, his white neck ring, and his reddish ruddy breast feathers --ARE NOT worn year round. They were grown this Fall for next Spring's mating season, when they would be useful to help identify this duck as a male duck -- or drake. Earlier this year, during part of the Summer and just after the nesting season, this male duck had a coat of feathers that looked almost exactly like the brownish feathers of his mate. When I plucked this duck I found a few of his brown Summer feathers that had not yet been lost. Return slide one and put slide two in the viewer.

Here's a Fall migrator and Winter hibernator that isn't a bird or a mammal. Have you seen any relatives of this "woolly bear caterpillar" crossing the road lately? If you'll pick up the INSECT book in the carrell, and turn to page 83, you can see what the banded woolly bear may become next Spring. The banded woolly bear is one of the few insects that hibernates during the Winter in its LARVAL - or CATERPILLAR - stage of development. Most insects either spend the Winter as eggs, pupa in a cocoon or chrysalis, or, like some queen wasps and bees, as adults. The woolly bear larvae shown in the slide will form a cocoon, and pupate in the Spring, and later emerge as a yellowish-tan moth - like the one in the bottom picutre on page 83. The woolly bears that you can find now on warmer Fall days, are searching for Winter homes, under leaf, bark, and dead grass material. Return slide two and put slide three in the viewer.

Mounted on an insect pin is a male snowy tree cricket. There is a possibility that you may find some of these crickets yet, but as cold weather comes, the adults of this species die, as do the adults of many kinds of insects. Before they die, snowy tree crickets mate, and the female lays eggs. The eggs - or at least some of them -- survive the Winter living conditions and the young insects hatch in the Spring when the temperature, food supply, and other living conditions are again favorable for growth. Insects' biological clocks, set by changing daylengths, chemically prepare insects for changing living conditions in much the same way that biological clocks work for birds and mammals. Turn to page 22 in the INSECT book for a moment. Shown on page 22 is the common black field cricket. This is another insect that you may find moving about in your yard or in a field -- or in your home. A female is shown on page 22 preparing for seasonal change. She is laying eggs that will stay in a resting state in the ground through the Winter. The male field cricket doesn't have the long egg-laying tube or "ovipositor" shown on the female. Male field crickets sing through much of the Summer and Fall. Some children I know, like to keep a male field cricket in a large tin can and wire cage in their home, so they can listen to his song. If you plan to catch a field cricket for a pet, be certain to design a cage that it can't chew its way out of. Field crickets will eat clothing and stored people food if given the chance, and they can become a pest in the house. Listen to the chirping song of the male field cricket--(field cricket "song"). Now lets go back to the tree cricket in the slide viewer. It too has what I think is an unusual but pleasant sounding song. Listen for a moment to the "song" or mating call of the MALE snowy tree cricket. Locating the source of such a song has helped me find insects during warm autumn evenings. (Snowy Tree Cricket song) You have just heard a song that the female snowy tree cricket CAN'T HEAR!

It seems that the female has no sound detecting parts on her body! Why then does the male sing so, during the Fall mating season? When scientists found that female tree crickets couldn't hear, they asked the same question. Then it was discovered that the male snowy tree cricket has a tiny cup-like space between his wings, that fills with an attractive perfume-like material when he rubs his wings together to "sing." Female snowy tree crickets can smell the perfume-like liquid and are attracted to it. I think this illustrates one of the most enjoyable things about stydying living organisms in their natural living places. We quite often find, on close inspection, that things aren't always what they appear to be.

The study of insect attracting perfumes -- now known to be produced by a number of insects -- may help people find a safer way of getting rid of some unwanted insects pests. People are experimenting with ways of using insect SOUNDS and SMELLS to attract insect pests to places where they can be easily captured. This may prove to be a far better way of getting rid of insect pests than spraying bug-killers all over our fields, gardens, and forests.

Return slide three, and put slide four in the viewer. If you would like to collect insects for an insect collection, you might try mounting your insects like this Katydid is mounted. A drop of glue on a small card is all that is necessary. Mounting insects on special insect pins makes it possible to see both sides of the insect, but mounting with glue is much easier, and still leaves most of the bug visible.

To make an even more useful insect specimen, one might write not only the name of the insect on the card, but also the DATE when it was collected, and the kind of PLACE where it was found.

Return slide four and put slide five in the viewer. Shown here is a metal insect cage that a friend of mine uses to house a collection of Brown Field Crickets. He can take the wire top off fairly easily when he needs to add more oatmeal, wheatmeal, bran, or other food to their food tray, or add more water to the fruit jar water bottle. The strips of paper on the right side of the cricket cage provide many hiding and resting places for his crickets. You may want to build a similar insect cage from screen wire, large coffee cans, or other materials, to house insects you might find outdoors. If you bring a few cold, dead looking insects into a warm room, you may find that some can become active again quite fast when they warm up.

Return slide five and put slide six in the viewer. Shown here is a track of an animal that is rather common in this area, but is seldom seen by people on field trips. Do you know what animal made this track?

Yes, it was a deer. The whitetail deer is not often seen by kids on field trips. Deer are active mostly during the evening and very early morning hours, and usually spend most of the daytime resting in hidden, "out of the way" places. They are also fairly shy animals, with excellent hearing and a good sense of smell. Unless you move very quietly through the woods and fields, you will seldom see a deer, even though you may walk within just a few yards of one. Late Fall is the mating season of the whitetail deer, and they seem to be less shy at that time.

Have you ever gotten close to a whitetail deer in the woods or fields? I was startled a few weeks ago when I discovered one watching me -- only about thirty feet away -- while I was taking photographs of some plants on a woodland floor. When I turned and saw the deer, I was so suprised that I forgot to raise my camera and take its picture before it bounded out of sight. I do try to get a record of what animals live in various places, when I can, and you might have some fun doing the same thing.

Return slide six and put slide seven in the viewer. I didn't see either the bear or the raccoon whose foot prints I copied, but I do have a record of both animals. If you find a nice, not "messed up" animal track in some mud, you can easily make the kind of plaster casts shown in slide seven.

If you carry some plaster-of-Paris in a dry milk carton, take another milk carton along for a mixing bowl, and a third container with some water, (if you think you'll be in an area where you can't find a stream, pond, or puddle,) you'll be almost set to make plaster track casts. I carry some "cut up" strips of milk carton material, and some paper clips to make a sort of DAM around a good track. After I pick out pieces of sticks and leaves that often land in tracks, I mix up a thick soupy mixture of the powdered plaster-of-Paris, and water, and pour it into the cleaned out track. A few strong small sticks or tooth picks can then be laid in the wet plaster, to reinforce the cast, if it is a large track. When, after ten or twenty minutes, the cast is almost dry, I scratch the name of the animal, the date, and the area where I found the track, in the back or exposed side of the cast. Then I wait until the cast is completely dry before I pick it up. The casts in this slide have been painted to make them easier to see in the photograph. You may want to take equipment along to make some plaster animal track casts on a Fall field trip.

Return slide seven and put slide eight in the viewer. Shown here is one kind of winter bird feeder that you can easily make from a discarded bleach bottle. I found that this one bounced about in the Winter wind when it was hung from a tree branch. You could nail one like this to the side of a building or attach it to the top of a clothes line pole, and the bird food wouldn't get bounced out in the wind. Shown with the feeder are some pumpkin seeds, sunflower seeds, and corn grains, that can be used to feed birds in the Winter. You might like to collect a variety of more NATURAL outdoor fruits and seeds during the Fall, and later see which kinds of seeds and fruits Winter birds prefer to eat. Return slide eight and put slide nine in the viewer.

Shown here is a Winter bird that has never visited my Winter feeding station. In fact, I've only seen one bird exactly like this one. That's because this bird is a "home-made" kind of bird. It was made from a rounded stone, a fifth grade girl picked up on a field trip. Some of the GRANITE OWL'S features were made from scrap pieces of felt, and some were painted on. Interesting stones and fossils can be collected on outdoor field trips most any time of the year. Return slide nine and put slide ten in the viewer.

You may want to bring some paper bags on a field trip to carry home some fall fruits and seeds, to make a Fall or Winter fruit arrangement like the one shown in this picture. I'm certain you could make an arrangement as nice, or nicer, than the one shown here. Often the fruit materials I collect in the Fall are wet, so I hang them upside down in a warm dry place before I start building an Autumn arrangement. Return slide ten and put slide eleven in the viewer.

Colorful leaves are a plant response to changing living conditions in the Fall. Shown here is a bulletin board display of dried and pressed leaves. This could be used for both decoration, and as an aid to help someone learn the names of some of the trees of the area. These leaves were placed in some paper towels and pressed in some large books, until they became very dry. Well dried leaves, even though they are brittle, will last many years if they are handled carefully. You or your teachers may know of other ways to preserve Autumn leaves. Return slide eleven and put slide twelve in the viewer.

Field trip collected Autumn leaves were used to make these brush prints and scatter prints. The outlines of the leaves make it easy to see similarity between the Sycamore leaf and the Maple leaf. Spatter prints are one way Autumn leaves can be used for decoration and study, and they can be easily passed around from person to person, or stored for later use, without having to worry about brittle leaves being broken. Return slide twelve and lets now look at the leaf photographs on the bulletin board.

Do you see the yellow colored Sugar Maple tree in the photograph on the bulletin board? Each Fall, in response to SMALL DAYLENGTHS, the leaves of Sugar Maple trees, like the leaves of many other trees and bushes, change color. The green color of Spring and Summer -- the color of the green pigment, CHLOROPHYLL, disappears. Chlorophyll disappears because the chemical processes that make chlorophyll inside the leaves begin to slow down and finally stop as the days become shorter and shorter. Other pigments -- that is, other COLORED MOLECULES -- appear. The orange and yellow pigments, common to many leaves in the Fall, are called CAROTENOIDS. One of these carotenoid pigments is found in the root of the garden CARROT plant, and the name "carrot" comes from the name of this orange pigment. The yellow and orange carotenoid materials aren't new to plant leaves in the Fall. These colors were there in the leaves ALL SUMMER! But as long as the plant was able to produce new chlorophyll during the summer, the yellow and orange pigments remained HIDDEN by the green of the chlorophyll.

Find the Red Maple photograph on the lower right-hand corner of the bulletin board. The Sugar Maple in the last photograph ISN'T able to produce the dark RED Autumn colors of the Red Maple. The dark red, unlike the yellow of the Sugar Maple, is a NEW color pigment in the Autumn. It is PRODUCED in the Autumn. The dark red of the Red Maple, some Dogwood bushes, and other plants, are not pigments that were masked by chlorophyll all Summer. These pigments, like the purple color of some kinds of Oak leaves and Grapes, and purple cabbages, can be produced only by plants that have INHERITED the ability to make these pigments.

You may have noticed that some years, the Autumn colors seem much more pretty than other years. Weather conditions in the Fall do differ from year to year, AND WEATHER CONDITIONS do affect the production of the dark red and purple pigments of leaves and fruits in the Fall. When we have long stretches of sunny days, and cold crisp -- BUT NOT FROSTY -- nights in early and mid Autumn, we get much more of the deep reds and purples produced in leaves of plants that are able to produce these colors. Frost not only DOESN'T HELP produce bright Fall colors, but frost can kill leaves early and cause them to STOP PRODUCING THE BRIGHTER COLORS. Frost, like wind, driving rain, and snow, can also strip our woodlands of most of their Autumn color.

Let's go back to the color slides now. Put slide thirteen in the viewer. Here is a Red Maple twig with four leaves. I cut this from a Red Maple tree LAST SUMMER, in early August. Notice the holes in the center of the leaf. These were made by a leaf mining insect. You will see a closer view of them in a later slide. Red Maple leaves were quite green in August, weren't they? But BIOLOGICAL CLOCKS in Red Maples had already gotten some changes started back in August!

Return slide thirteen and put slide fourteen in the viewer. Slide fourteen is a closer view of the SAME Red Maple twig that you saw in the last color slide. Here you can see some of the buds that were on this twig, and the leaf stems or PETIOLES of the four leaves. Can you see that ALREADY IN LATE SUMMER the buds shown in this picture were quite large, and fairly easy to see? How many buds can you see in this slide? Keep this slide in the slide viewer, and look at the upper, left-hand color photograph on the bulletin board.

This photograph is another picture of the SAME TWIG that is shown in both slides thirteen and fourteen. Before I took this picture, I took one leaf completely off the twig and pulled another leaf loose. Can you see that only three leaf stems or PETIOLES are shown in the upper left-hand photograph? One of them is separated from the twig. Take a close look at the end of the leaf petiole that is not quite connected to the twig. Can you see the spot on the twig where this leaf petiole was attached? This spot on the twig is called a LEAF SCAR. There is a small circle with a smaller dot in the middle of it, in the leaf scar. Please notice that the plant material on the leaf scar and the material on the end of the "pulled off" leaf petiole ARE NOT all shredded and torn. It was NOT AT ALL DIFFICULT to pull the leaves off the twig in late summer. In fact, they had already begun to separate from the twig before I cut the twig from the Red Maple tree. As early as LAST AUGUST, this Red Maple tree's biological clock had already started leaf separation processes -- even though the leaves of this Maple Tree don't usually fall off until mid-October!

Now look at a further enlargment of the SAME TWIG in the enlarged photograph on the upper, right-hand corner of the bulletin board. How many leaves are attached to the twig in this picture? That's right, there are NO leaves attached. I pulled them off and then twisted the maple twig slightly, before I took this picture, so that you could see that there are FIVE BUDS on this twig, and so that you could get a better view of a leaf scar. Can you see the three buds at the end of the twig, and a fourth bud just above a leaf scar near the bottom of the picture? Just an edge of the fifth bud can be seen hidden behind the twig directly behind the fourth bud. There is an END bud and four side buds on this twig. There is a side bud above EACH of the four leaf scars.

Look back at the other maple twig photograph, and then at slide fourteen, and you can see how the end of each LEAF PETIOLE was slightly wrapped around a side bud. These buds have in them the beginnings of NEXT YEAR'S new leaves and new branches. Can you see that Red Maples begin preparation for the coming Spring growing season and Summer food making season over six months in advance?!

Now we'll use these photographs of the Red Maple twig to figure out WHAT BENEFITS leaf loss may have for trees like Red Maples. In the Fall the leaves of trees such as Red Maples no longer have enough chlorophyll to make food. The cold outdoor temperatures of late Fall and Winter are TOO LOW to allow much plant growth, and the temperatures are also TOO LOW to allow much food making in leaves.

Leaves of maples, ashes, elms, sycamores, and the like, would serve very little purpose for the plant during the cold season. In fact, if the leaves stayed attached, they could cause the plant some HARM. The leaves could cause the plant to DRY OUT in the cold winter winds.

Look at the V-shaped leaf scar on the upper, right-hand photograph on the bulletin board. Three sets of "FOOD AND WATER TUBE BUNDLE" scars are labeled in the leaf scar. Water that enters the roots of the Red Maple tree, travels up the trunk and branches of the tree through special WATER TUBE CELLS. Bundles of these water tube cells extend out from the smaller branches, or twigs, into the leaf petioles, and branch out as LEAF VEINS in the flat part of the maple leaf. Return slide fourteen and put slide fifteen in the slide viewer.

Slide fifteen is a close-up picture of some of the branching water and food tubes of the flat leaf blade. The water that comes into the plant through its many roots, goes up through the plant and finally out into each of the hundreds of leaves. A TINY BIT of the water is used with chlorophyll, carbon dioxide of the air, and sunlight energy, to make food. But MOST of the water that enters a plant, IS NOT USED CHEMICALLY by the plant -- it simply goes up through the plant and out the leaves, through THOUSANDS of tiny holes in the surfaces of leaves! Many kinds of plants can't afford to lose water through its leaves surfaces in the Winter time. When the ground is cold or frozen, water can't enter plant roots fast enough in many kinds of plants to replace water lost by the leaves. Scientists have found that the leaves of evergreen plants - that is plants like pine trees and wintergreen - have special structures on them that help prevent the rapid loss of water in the Winter time. But for plants like red maple trees and many others, losing their leaves in the autumn is another change that is necessary. Losing their leaves helps them survive changing living conditions. If such plants didn't lose their leaves in the Winter, they would probably dry out and die.

Leaf changing color and leaf dropping in the Fall are two more examples of how some living things adjust for changes in living conditions. The green chlorophyll is useless to many kinds of plants that can't chemically make food in the cold weather of Winter, and loss of water through leaf surfaces is dangerous to most of the same plants in the Winter. Preparation for both color change and leaf loss in controlled by the plants' biological clocks. And these clocks in turn, use the shortening daylengths of late Summer and early Fall as clues to get the changes started.

Return slide fifteen and put slide sixteen in the viewer. You saw a slide of this plant earlier in these lessons. Do you remember what it is? This is poison ivy again. Its leaves may look like this outdoors now. Please remember that it has three leaflets, that is, its leaf blades are found in groups of three. Don't take some of this plant home for Fall decorations. You may find some with its fruit on. The fruit of poison ivy are grayish-white berries and they are dangerous too. Return slide sixteen and put slide seventeen in the viewer.

Shown here are some of the kinds of things you might bring with you on a Fall field trip, if you plan on doing some collecting. Coffee cans or plastic containers with lids are handy to carry salamanders, snakes, insects, or other small animals in. Milk cartons are excellent to carry soil, seeds, small fruits, or pond water in. Newspapers and paper sacks can be used to fold around leaves and larger fruit stalks, and paper plates or pie plates are useful to dump leaf litter or soil in, when you want to examine it for insects or other living things. Ask your teacher what you might bring on the class field trip.

There are three twigs in a plastic box in the carrel. The twig with THE GREEN tape is Black Walnut, the red taped one is White Ash, and the yellow taped one is from the Shagbark Hickory. While the tape is rewinding, and for a few minutes later if you wish, look these twigs over and compare the funny-faced leaf scars of the walnut with the leaf scars of the ash and hickory.

You can rewind the tape now. Don't forget to push the stop button again when the tape recorder has finished rewinding the tape. Goodbye.

LESSON SCRIPTS

AUDIO-TAPED SCRIPT, WINTER LESSON NUMBER ONE

Hello. How are you today? Today's lesson is the first of three winter lessons I've prepared to help you get ready for a WINTER field trip. If the winter seems to you like a strange time to go on an outdoor field trip, it may be because you've missed the fun of hiking or exploring outdoors in the winter. If you dress yourself correctly, as if you were going sleding or ice-skating, you'll find that winter field trips offer many things that trips at other times of the year don't offer. An almost leaf free, clear view of the countryside is one benefit of winter field trips. Freedom from the bothersome hum and bites of mosquitos is another. And if you have snow in your area, the snow covered ground offers you a footprint RECORD of the animals that were active since the snowfall.

Do you remember how to work the slide viewer? Take slide one, put it in the slot, and practice with it a minute if you think it necessary. Don't forget to push the white plastic bar down to make the slide viewer light come on. If you must stop the recorder, remember to push the play button, button number one, when you are ready to begin again.

Do you remember how the slides are used in these lessons? Please have the slide I'm talking about IN THE VIEWER, WHEN I'm talking about it. Put slide number one in the viewer now, if it isn't already there.

Slide number one shows a mother and her two small children taking a hike on a sunny winter morning. I included this slide to remind you that field trips with TWO or THREE friends give you a much better chance of seeing wildlife than trips with ten or twenty friends. Why don't you plan some winter outings with your family or with a few friends soon?

Leave slide one in the viewer a moment, and look at the bulletin board pictures. Can you guess from the drawings, what today's lesson is about? Yes, it's about FOOD. Food is one of the materials that all living things need. And it is THE one that is most hard to get in the winter time for many living things. We people know how to preserve food by canning and freezing it, and how to store food so that we can continue to get it during the winter. We also are able to bring foods to where we live from places where fruits and vegetables are grown in the winter and where beef cattle, hogs, chickens, fish, and other meat products are raised or caught. EACH DAY you and I need some of EACH of the four basic kinds of foods shown in the pictures on the bulletin board. And being people, we have figured out ways of getting our needed foods.

Each day you and I need some fruits and vegetables like those in picture one, and some dairy products like those in picture two. To get the protein we need to grow and to repair worn out body tissues, we also need some animal products each day -- such as the fish, poultry, eggs, or beef shown in picture three. Also needed daily by people, are grain or cereal products, such as the cereal and baked goods illustrated by picture four. We get needed vitamins and chemical elements found in minerals from cereals and goods made from flour. We get other vitamins and chemical elements from other plant materials, and from dairy products.

Wildlife too have daily basic food requirements. Each day winter wildlife need food to furnish energy to keep them warm, and energy for moving about to find more food. They need a number of kinds of vitamins and minerals in order for their bodies to continue to carry on life's chemical processes. Wildlife don't require the exact SAME foods that you and I do, but if wildlife are to remain active in winter, they need nourishing food that they are able to eat, and digest, and use. Some wildlife eat only plant materials. Some, only eat animals. And some eat both plants and animals, just as people do.

Return slide one and put slide two in the viewer. Here's a table set with a meal that would leave you feeling hungry! The paper turkey decoration in the middle of the table fooled no one -- and no one came to dinner. In the winter, most leaves are dead and have fallen, and there are MANY such EMPTY TABLES outdoors. Many places that had lots of green juicy leaves during the warmer seasons, are empty now. And now they don't attract the leaf eating mammals and leaf chewing insects that they did last summer. Neither do they attract animals that use the leaf eaters for THEIR FOOD. Return this slide, and put slide three in the viewer.

Shown on the table here, is a roast turkey. It was the beginnings of a real meal, and it attracted seven people to the table. Roast turkey is nourishing, but it alone isn't enough to fulfill people daily food needs. More food followed the turkey to this table after I took this picture.

The reason this picture is in today's lesson, is to help you understand that wildlife, like the people shown here, ARE ATTRACTED TO AREAS where FOOD can be found. If active winter wildlife can find enough of the kinds of food they need, they will survive the cold and harsh living conditions of winter. Those wildlife that don't get enough food, often become to weak to escape animals that use them for food, or they die from starvation, diseases they are too weak to fight, or from lack of enough heat energy to combat the winter cold.

Each of the different kinds of winter wildlife know what foods they need, and like the people that came to dinner in this picture, wildlife GATHER where they can find the particular kinds of food they need. Return slide three and put slide four in the viewer.

If you'd like to attract some feathered winter wildlife, and often some furry ones such as squirrels too, a backyard feeding station like the one shown here will usually do it. The kinds of birds and mammals that come will depend on the kinds of food that you serve, and the kind of area you live in. Do you remember the bleach bottle bird feeder that was in one of the autumn lesson slides? It is easy to make. Your science teacher has some plans for other easily made bird feeders. I must warm you now that unless you remember to keep some food at your feeders until spring arrives and new food becomes available, you can do the wildlife more harm than good by attracting them to a feeding place. Often wildlife will learn to depend on finding food at a feeder, and get out of the habit of finding natural food at other places. If you forget to keep food available during long stretches of cold weather, some wildlife may starve while waiting for your food.

The occasional feeding of deer in the winter by well meaning people often ends up with starving deer, or with deer being attracted to areas where dogs can easily get to them and run them to exhaustion and death. For these reasons, winter deer feeding is frowned on by many people who are very much concerned with the well being of deer. Return slide four, and put slide five in the viewer now.

Here is a common winter wildlife food in much of our country. Where corn or other fruit is left unharvested, or where some is left in the fields after harvesting, you can expect to find much winter wildlife. Many kinds of winter wildlife have learned to live quite close to people in farming areas where some corn, soybeans, wheat, or other farm products remain in the fields after harvest time in the fall. Return this slide and put slide six in the viewer.

Here is some wildlife evidence or SIGN that is a common sight in wooded areas near corn fields in the fall and early winter. Do you know what animal left these corn cobs and corn husks at the bottom of the tree? Return this slide and look at slide seven for the answer.

Where corn is abundant, and trees for nesting sites are nearby, squirrels can usually be found. The squirrel shown here is the Gray Squirrel. It is common in this area, and common over much of the eastern half of the United States. Can you think of other animals that eat corn in the winter?

Fruits and seeds -- such as corn, walnuts, acorns, beechnuts, and weed seeds, produced during the summer and fall from flowers, are the main source of FOOD for active winter animals. The many different kinds of fruits and seeds produced last summer and fall are the MOST ABUNDANT TYPE OF FOOD NOW, and the most common types of animals you can find in the winter are those animals like gray squirrels that eat fruits and seeds. Return slide seven and put slide eight in the viewer to see another fruit and seed eater.

This Red Squirrel is smaller in size than the gray squirrel. It is called a "Chickary" in some parts of the country. Like other kinds of squirrels, the red squirrel is also a fruit and seed eater. Red squirrels prefer Hickory nuts in the fall, acorns year round when they can get them, and they rely on the seeds of hemlock, pine, and spruce trees in many places in the winter. Return slide eight and put slide nine in the viewer for a look at another fruit and seed eating animal.

The Deermouse shown here is eating some lemon flavored fruits that you may have tasted while on a fall field trip. Do you remember having seen the fruit of Sumac bushes? Deermice, common all over the United States, eat all sorts of seeds. They like berries and nut type fruits too.

Many of the seeds and fruits that are eaten by deermice and other winter fruit and seed eaters, are NOT FROM FARM RAISED plants. Winter wildlife were around this area long before people started farming, and many kinds of wildlife prefer the foods their ancestors were used to eating hundreds of years ago. Squirrels for example, eat much more NATURAL FOOD than farm raised food. Return slide nine now and take a look at a common natural food in slide ten.

The acorns shown here were collected during a winter when there were alot of acorns available. But not every winter is that way! Sometimes, because of a late spring frost, many oak flowers are killed, and FEW acorns produced. During a winter that follows such an event, many wildlife starve, and others, because they are weak, are not able to produce and care for offspring during the spring that follows. Many kinds of wildlife besides squirrels depend on acorns for nourishment. Acorns, along with Beechnuts, are the main food of black bears in the fall. Various kinds of acorns are eaten by deer throughout the country, and they are the MAIN FOOD of the white-tailed deer in snow free places such as Texas during the fall and winter. Many gamebirds and songbirds also depend heavily on acorns. By the way, did you notice the face drawn on one of the acorns in this picture? That acorn was about to be made into the head of a doll by a friend of mine. Return slide ten and in slide eleven you'll see a noisy bird that eats many acorns when it can find them.

Do you know the name of this bird? This is a Blue Jay. During the summer, Blue Jays eat mostly insects. They occasionally catch frogs and even mice, and during the spring nesting season they will eat the eggs and young of other song birds if they find them unprotected. But during the winter, acorns, corn, beechnuts, pine seeds, and other seeds and fruits make up most of the diet of Blue Jays. Return this slide and put slide twelve in the viewer.

Here is a friendly songbird that is the favorite bird of all of my daughters. Like Blue Jays, Chickadees eat many insects in the warmer months. They eat mostly seeds and fruits, such as pine, hemlock, birch, and weed seeds, and poison ivy berries in the winter. Although many animals eat the wild rose fruit shown in this picture, I've never seen chickadees eat them. Chickadees are fond of sunflower seeds when they can get them from native sunflowers or from bird feeders.

Chickadees also continue to eat insects and insect eggs in the winter. A few chickadees living around an orchard in the winter can help eliminate many kinds of insect pests from orchard trees before the insects become active and have a chance to damage the trees in the spring and summer. Return slide twelve and put slide thirteen in the viewer.

The cardinal has a beak well designed for cracking open dry fruits and seeds. This bright red bird is the male cardinal. The female, or mother cardinal also has a large beak and a crest or tuft of feathers on the top of her head. But she is more subdued in color -- a sort of yellowish-grayish brown color. If you give the following whistle-like song when you hear a male cardinal singing during late winter, he will usually sing back to you, and continue to whistle for a long time. (Male cardinal "What Cheer" song.) I'll try that once more. (Repeat song.) Return the slide of the cardinal, and put slide fourteen in the viewer.

Earlier in this lesson I mentioned that different wildlife need different kinds of food. Different animals have different mouths and feeding devices, and they have slightly different ways of digesting their food. Here's a winter resident of this area, that has a diet much different from that of the fruit and seed eaters. This Barred Owl, most often found in swampy woodlands, is a PREDATOR. The main food of this owl is mice. Barred owls, like other kinds of owls and many kinds of hawks, are mans' most effective mousetraps. Owls also eat rats, rabbits, frogs, crayfish, large insects, some small birds, and some gamebirds and poultry if given the chance. But when it comes to control of one of the farmers' and orchard peoples' most numerous pests -- the field mice -- our native owls are our best friends. Return this slide and put slide fifteen in the viewer.

Shown here are some OWL PELLETS. Owl pellets are small balls of fur and bones, and ocassionally some feathers, that are coughed up by owls after the nourishing parts of their food have been separated and digested. Owl pellets are not stinky or messy to handle, and they tell scientists much about what owls eat. Most of the material in owl pellets is hair. Bones and teeth are usually found on the inside. Can you see the mouse bones and teeth in the "pulled apart" owl pellet? Return slide fifteen and take a look at another predator in slide sixteen.

This little woodland bird is a Downy Woodpecker. It is small enough that it could rest on your hand. But it is a predator, like the barred owl. It doesn't catch mice or frogs or rabbits. It preys on insects. The wood=boring larvae of various beetles and other insects are a main source of food for the downy woodpecker. By catching such pests, this and other kinds of woodpeckers are very helpful in protecting lumber and orchard trees. Like owls, woodpeckers by their eating habits help cut down pest populations. Return slide sixteen and put slide seventeen in the viewer.

The Nuthatch shown in this slide is also a predator much of the time. Like the woodpeckers, it too eats a variety of bugs. I enjoy watching nuthatches in the woods. Often they fly to the top of a tree and busily around and down the tree trunk, UPSIDE DOWN, pecking insects or insect eggs out from cracks in the bark. When they approach the bottom of the tree, they fly to the top of a nearby tree and start down it. Some suet hung near a feeding station will attract both downy woodpeckers and nuthatches. Nuthatches, as their name seems to indicate, do eat some plant materials too. Like chickadees, nuthatches seem to prefer sunflower seeds at feeding stations. Return slide seventeen and put slide eighteen in the viewer.

Animals that are able to eat, and to use, MANY DIFFERENT KINDS OF FOOD, often have a big advantage over animals whose diet is restricted to just a very few kinds of foods. Crows, opossums, skunks, and rats are examples of such animals. So is the raccoon, shown here. These animals are able to get nourishment from many different kinds of food materials. All of them will visit, and enjoy the variety of things they can find in garbage cans if the lids are left off the cans. Raccoons have nimble enough fingers and sharp enough wits, that they can often remove the lids from garbage cans. Raccoons eat frogs, crayfish, and grasshoppers, when they can be found in the warmer months, and they stuff themselves on acorns, corn, wild grapes, and other things in the autumn. Raccoons develop a thick layer of fat and sleep through much of the winter. But whenever a stretch of warm weather comes along in the winter, raccoons will leave their dens in search of whatever food they can find. Return slide eighteen, and put slide nineteen in the viewer.

Not only the raccoon changes his diet as the seasons change, but many other animals must change their diets too. The browsing animals -- those that rely on tender leaves and non-woody shoots and stems, during the warmer months, must either change their eating habits during the winter, or they must hibernate, migrate to warmer climates, or die.

Many of the leaf eating insects lay their eggs in the fall, and then die. As thousands of insects disappear in the fall, hundreds of insect eating song birds migrate to warmer climates where they can continue to find insects to eat. Leaf eating woodchucks hibernate, but some leaf eaters -- that is BROWSERS, remain active. To remain active, they must change their eating habits in the winter in our area. The twigs in this picture have had some bark, buds, and the more tender ends chewed off by some such browsing animals. Do you know what some of the winter bark and small twig eating animals are? Cottontail rabbits did the eating of the branches shown here. The bark and small twigs of sumac, red maple, wild cherry, and apple trees are favorites of cottontails. n fact, cottontail rabbits can become pests in apple orchards during the winter months, by eating the bark of orchard trees exposed above the snow.

The field mouse can become an even bigger pest in orchards in the winter. They can chew away at the bark of apple and cherry trees while staying under the snow, and they can remain hidden from the eyes of hunting owls while they are eating. Return slide nineteen and put the last slide in the viewer.

If you thought that DEER was a correct answer to the question about winter bark and twig eaters, you were right too. Deer, such as the white-tailed deer shown here, switch from the softer leafy foods of summer, to the small twigs and bark of some bushes and trees. Not all kinds of bushes and trees furnish nourishing food for deer, rabbits, and field mice however! Deer are much larger animals than rabbits and field mice. The average sized deer requires about SIX pounds of high nutrient browse material EACH DAY, to stay healthy. Look at the plastic bag of good deer browse material in the carrel. It has twigs, buds, and bark of red maple trees, two types of dogwood bushes, some hemlock -- the evergreen -- and some sumac. The browse in the bag weighs about ONE POUND. It takes SIX TIMES THIS MUCH good deer browse EACH DAY, to keep an average sized deer healthy. If the deer can't find nutritious food like that in the bag, they must have EVEN MORE each day. I would have put some apples and acorns in the bag too, because they are good deer food. But apples would spoil in the bag, and I could find no acorns under the winter snow.

There are other good deer food trees and bushes available in this area too. Honeysuckle, elderberry, and witch hobble bushes are good. The buds and ends of the twigs of young basswood trees, striped maple trees, and mountain ash trees are preferred by deer.

Only a few evergreen trees and bushes furnish good food for deer. Hemlock, yew, and white cedar are nutritious. But pine, spruce, juniper, and tamarack trees offer only stomach stuffing. When you find areas where deer have been feeding heavily on pine, spruce, juniper, and tamarack trees, you are in a place where the deer are in danger of starvation.

Many kinds of non-evergreen trees, such as beech, gray birch, hawthorn, and aspen are also poor food or starvation food for deer. Like pine, spruce, and others, they are sometimes eaten by deer to help satisfy their apetites, when the deer can't get to good food.

Thick forests of pine or other low nutrient trees and bushes may offer deer protection from the winter wind, but they offer little or no food for deer. During winters when we have deep snow for many weeks, and deer find it very hard to travel to find nutritious food, many deer starve to death with stomachs full of STUFFING FOOD.

We'll look at some slides of good places to find healthy deer, and other winter wildlife in the next lessons. You'll also see slides of animal tracks and other evidence of wildlife activity.

Please return slide twenty now, and check to see that the other slides are in the correct order for the next person. To rewind the tape, please push the STOP button first, and then push the REWIND button. When the sound of the tape rewinding is finished, remember to push the stop button again. Don't forget to write today's date after your name in the lesson one column of the LESSON USE CHART. Goodby. Push the stop button now.

LESSON SCRIPTS

AUDIO-TAPED SCRIPT, WINTER LESSON NUMBER TWO

Hello. I hope you are feeling fine today. This is the second winter lesson I've prepared to help you get ready for a winter field trip.

Have you had a chance to play the wildlife ecology gamed called, "How Was Your Winter?"? This game is a part of your winter environmental education lessons. One of your teachers has a copy for use by members of your class. If you and two or five of your classmates get your other school work done early some day, your teacher may let you play the game. It takes either three or six people to play the game. A copy of the gameboard from "How Was Your Winter?" is on the bulletin board for this lesson. You'll see slides of examples of most of the wildlife habitats on the gameboard, in your lesson today.

Do you remember what the last lesson was about? I hope you didn't get too hungry during winter lesson number one, because of the talk about food. Seeing that it was about wildlife food, rather than people food, maybe you didn't get hungry. I'm certain though, that some wildlife in this area have gotten hungry since you went through lesson one.

Put slide one in the viewer now, and take a look at a path made by deer looking for some unharvested corn to eat. Can you see the deer path cut through the snow?

Finding food in the winter is a job that takes most of the active time of wildlife. Just like you and I, wildlife need a daily supply of good nourishing food. When the corn from the field in this picture is gone, the deer and other wildlife that eat it, will have to look elsewhere for food. If your food supply gets low, or runs out for a time, life gets pretty miserable. Wildlife can't go to the grocery store like you and I might be able to do. Low food supplies -- and even NO FOOD supplies -- happen in areas where there are too many wildlife that eat the same things. That is, it happens where a population is too high.

Not being able to get enough food doesn't happen only to wildlife. There are places in the world where food for PEOPLE is scarce. In some of these places, the lives of people are not much better than the lives of weak, hungry, unhealthy wildlife. Even though I enjoy our winter wildlife, I worry much more about food becoming scarce for people than for wildlife.

One way you and I can help prevent PEOPLE HUNGER and PEOPLE STARVATION, is to make good use of the food we have by not wasting it -- by not eating more than are bodies need to keep healthy. Return slide one, and put slide two in the viewer now.

Wildlife, like people, need more than food to stay healthy. Another thing they need when the weather becomes cold, is COVER. By cover, I mean protection from the chill of winter weather -- especially from cold winter winds that take away body heat rapidly. There are rows of young conifer trees in this picture. They don't provide much food for wildlife, but they do offer protective cover from strong winds. The word "cover" is also used to describe another kind of protection. Cover also means a hiding place from the eyes of hunting predaceous animals. The conifer trees shown here do provide concealment or hiding places for many kinds of wildlife.

The conifer trees -- that is, CONE BEARING TREES -- that are shown here, are Spruce trees. Some of these trees had spruce cones that held seeds. Deermice and some birds did visit this spruce plantation to eat the seeds. The thick, sharp pointed needles of the spruce trees also provided cover for them, as they did for other wildlife. But if you find a place where deer have been trying to eat spruce needles, you are in a place where the deer may be starving. Spruce needles will help satisfy a deer's hunger, but they won't provide deer with usable carbohydrates, proteins, fats, and vitamins. Return slide two and put slide three in the viewer.

Slide three shows an area that provides both food and cover to deer. This area has young trees. It has some conifer trees. It has brush. It has weeds. And in the area near the cat-tails there is a small stream that provides water, except at times when it is very very cold. An area like the one in this picture--an area that has plants of many different KINDS and plants of many different SIZES, usually provides both food and cover for many different kinds of winter wildlife.

If you want to find a variety of winter wildlife, try hiking around the EDGES of woodlots, or the EDGES of fields. Usually the edges of woods, fields, and streams and ponds, have the variety of kinds of plants needed to provide both food and cover for winter wildlife. Places like these are where you'll find the wildlife. On the gameboard in front of you, such areas like these, are the areas called, "Young Trees and Brush," and "Brushy Area with Weeds," and the area called, "Brush Piles in Weedy Fields." While playing the game, you'll find that these areas offer both food and cover to almost all the prey animals in the game. Return slide three and put slide four in the viewer now.

Most of the area in slide four is OLD HARDWOOD woodland or forest. But the area in the middle of the picture is different. The old trees -- hardwood trees such as Ash, Maple, Oaks and the like -- have been cut out of the small area in the middle of the old hardwood woods. The remaining tall trees of the surrounding old woods, offer both food and cover to squirrels and deermice. But they don't offer food and cover to most other kinds of wildlife. The cutover area has grown up with young bushes and young trees. Many small saplings have grown from the stumps of cut trees. Now this lumbered out or cutover area has tender bark and buds within easy reach of rabbits and deer, and the cutover area offers both food and cover for these animals. The low bushy growth offers cover and food for ruffed grouse and some songbirds too.

Here is an example of how people can change an area in such a way that the area is IMPROVED for some wildlife species. People can change areas so the areas provide better food and cover opportunities for PEOPLE, too. Changing an area calls for much thought and planning. Too often people have changed areas in ways that have caused living conditions to be made poorer for both wildlife and people. Whenever we plan to change an area, much study and planning should be done before we begin, because EVERY CHANGE we make on the face of the earth, causes OTHER CHANGES for living things. Before we change our earth, we should know in advance, WHAT the other changes will be.

Return slide four, and put slide five in the viewer now. Here is a picture of some tree stumps in a cutover area. Can you see the young sapling branches that-have grown out of the stumps? The Red Maple trees that were cut, have already started to grow again, and their branches and buds offer food to hungry cottontail rabbits and deer. Return slide five and put slide six in the viewer.

Slide six shows a fairly old CONIFER WOODS, or cone bearing tree woods. It was planted about forty years ago so that it would provide lumber for building in the future. The area at the middle top of the gameboard is supposed to represent an area like the one shown here. On the gameboard, the area is called and "Old Conifer Woods." Although deer might enter an old spruce forest like this during a severe winter storm, or they might travel through it on their way to another area to find food, you won't usually find much sign of deer in old spruce plantations in the winter. There is nothing for deer to eat in a spruce plantation like this. Notice that there is little undergrowth in this spruce woods. There is so much shade, few plants can grow on the forest floor in the summer. It is very cool and pleasant in a tall spruce or pine woods in the summer. But in the winter there is little food for animals other than some birds and the tiny red squirrel. The only kind of seeds available for food for winter wildlife are seeds that might be stuck in the spruce cones, high in the air. There is no low browse for rabbits and deer. This is not the best place to look for winter wildlife. Return slide six and put slide seven in the viewer now.

This picture returns us to good winter habitat for many kinds of wildlife. Along this stream are the fruits and seeds of many kinds of plants. Many kinds of bushes grow here, as well as many kinds of young trees -- and there are a few older trees too. When I took this picture, I was surrounded by cardinals, chickadees, woodpeckers, nuthatches, and some migrant finches -- birds of northern United States and Canada. The ground in this area was heavily tracked with the footprints of cottontail rabbits, gray squirrels, ring-necked pheasants, deermice, weasels, and a ruffed grouse. This area had a variety of plants. It provided a variety of foods and types of cover. AND it had quite a variety of animals. Return slide seven, and put slide eight in the viewer.

Slide eight is a close-up picture of one of the many brush piles that were in the area of the last picture. The kindly farmer who owned the land had cut down some of the bushes and some of the trees, and had left much of the wood in small separated piles. He did this to help provide food and cover for wildlife, because he enjoys seeing wildlife around his farm.

If you look closely at this picture, you'll see that he added something extra to this pile so that it would provide even better cover, and it would also help hold the soil in place in case of any late winter or spring flooding along his small stream. Can you see the roll of old wire that the farmer covered with brush in this pile? It is just about in the middle of the picture. The wire and the brush help anchor the soil. This farmer didn't have to worry very much about his good soil being carried away in floods, because he had done many things to prevent flooding on his land. Return slide eight and put slide nine in the viewer.

I took this picture in another fairly good wildlife habitat. This old tree was left standing in an area where most of the old trees had been lumbered out. This tree now provides winter homes for a number of different animals. If you had climbed up where the wind broke the top off the old tree, and then looked down inside, you would have seen a raccoon taking a winter snooze. The tracks leading up to this tree, indicated that it must have been there when I took the picture.

Many other animals, including songbirds, deermice, and squirrels find winter homes in such old trees, too. Such old trees are sometimes called "apartment house trees," or "den trees," because so many animals find homes in them. Return slide nine and put slide ten in the viewer now.

Do you know what wildlife species built the nest shown here? The builder didn't have feathers. It was a furry animal with a bushy tail. Yes indeed, this is a squirrel nest. The leafy squirrel nest shown here, was built by gray squirrels, mostly for summer use when tree top breezes give relief from summer heat. Gray squirrels will sleep in this kind of nest in the winter too, but they seem to prefer holes in old hardwood trees or old conifer trees for winter homes.

A winter hike through a hardwood forest, or a forest made of a mixture of hardwood trees and conifer trees, can give you a fairly good idea of the size of the squirrel population in the area. Squirrels' leafy nests are not easy to see in the warmer months, when the trees are leafed out. But the nests are easy to spot in the winter. If you have a hardwood, or a mixed hardwood-conifer woods near where you live, you might enjoy making a winter count of squirrel nests. If you write down the number of nests you count in a woods, and record the number where you can find it the next year, and the next, you could gather some interesting data about how squirrel population sizes change over a period of years. If you also keep a record of what years the woods has a good nut crop, and what years corn is planted near the woods, I think you would discover that the amount of food available to the squirrels has much to do with HOW MANY squirrels you have the next season. Do you have a wooded area with squirrels near where you live? Return slide ten and put slide eleven in the viewer now.

Shown in slide eleven are fairly large numbers of ducks and geese, that are not common to this area in the winter. There is even a swan in this picture. Can you see the large white bird? It is larger than the white snow geese. I imagine you've guessed that this picture was taken at a refuge or sanctuary. At this bird sanctuary, food and cover are provided for waterfowl and other animals by people.

Many people enjoy visiting wildlife sanctuaries. Wildlife sanctuaries are about the only places where you and I can expect to see some animals on the face of the earth today, because poor thinking and poor planning by people has eliminated some species from all other places. Even in sanctuaries or refuges, the lives of the protected animals are not always healthy. A hardwood forest can provide food and cover for only a certain NUMBER of squirrels. A pond can provide food and cover for only a certain number of fish. And even with feeding by people, a wildlife sanctuary can provide food and cover for only a certain NUMBER of different animals. When there are too many animals in an area, some must go, or the overcrowded conditions can cause all of the animals to get TOO LITTLE TO EAT -- too little to remain healthy.

Overcrowded conditions can also attract a larger than normal number of predators, and because of the overcrowding provide too little cover and protection from the predators. One very important job of the people who run the sanctuary where I took this picture, is to try to keep groups of dogs that are attracted by the waterfowl and by other animals, from killing the animals.

I can't blame hawks and owls and other predators from being attracted to such areas. When we people create refuges that bring many animals together, we must realize that we are setting a table full of food, and inviting predaceous animals to visit for an easy meal. People used to raise flocks of chickens in large numbers and keep the chickens in small areas with little or no protective cover. By doing this, they invited foxes, weasels, minks, raccoons, hawks, and owls to come and enjoy easy-to-get meals. A well run and well planned wildlife refuge requires that we be certain there is enough cover and enough food provided for the animals. Return slide eleven and put slide twelve in the viewer.

Do you know what animals build this kind of house? This is a beaver house -- or beaver lodge. The well built beaver lodge and the ice cover on the pond around the lodge, provide beavers with cover. A number of exits, or "doorways" lead out of the bottom of the house, under the water. Beavers use these exits to swim to piles of food on the bottom of the pond. Beavers pile up branches of Aspen trees, Willow trees, Birch trees, and Alder bushes on the bottom of their pond during the warmer months of autumn. They stick branches and sticks in the mud on the pond bottom. This keeps the branches and sticks from floating to the pond surface. Return slide twelve and put slide thirteen in the viewer.

The clear, almost leaf-free view one can get in winter, gives a hiker a chance to see many summer nests and dens that are hidden from view during the warmer months. This nest was built on a board in a small abandoned building. Even the building is hard to see in the summer because of the bushes around it. This nest has a lining of dried mud. Do you know what songbirds make a nest like this? This one was made by robins. I didn't disturb this robins' nest because I know that the same pair of robins might be back next spring to build another nest ON TOP OF this one! Robins seldom build new nests on old ones in trees and bushes. But they often build on top of old nests that have the firm support of a building. Return slide thirteen and put slide fourteen in the viewer.

There are bird nests that you can feel free to take back to your school or to your home for study. And bird nests are a lot of fun to study. It is amazing, how many kinds of materials different birds use in building their nests, and how many different kinds of ways there are to build nests. An especially good time to look for bird nests in the winter is shortly after a snowfall. Slide fourteen will show you why. This is a picture of a brushy and weedy field. The wildlife habitat area on the gameboard called, "Brushy Area with Weeds," is supposed to be the kind of area you see in this slide. Can you find the "Brushy Area with Weeds" on the upper right-hand side of the gameboard? Now look at slide fourteen again. Do you see a white spot in the bushes? It is a small spot, just about in the middle of the picture. When you've seen the white spot, return this slide and put slide fifteen in the viewer. Slide fifteen will show you what the white spot was.

The white spot was a cap of fresh snow on the top of a bird's nest. By looking for such white snowcaps, you can spot bird nests from a long way away. You'll find some in bushes, some quite close to the ground, and some in trees. And you can see them for a long distance while you are walking down a road or a trail. Return this slide and put slide sixteen in the viewer.

I like to find bird nests in the winter for a number of reasons. I spotted this nest by its snow cap on a day when I wasn't carrying my camera. I came back a few days later to take this picture -- for a special reason. Do you see the hole in the middle of this Red-wing Blackbird's nest? This nest had A ROOF on it and it was being used as a winter home BY ANOTHER ANIMAL. I wanted to take the animal's picture. Return slide sixteen and put slide seventeen in the viewer to see the animal that was living in the Red-wing's nest during the winter.

A friend of mine came back with me to the nest. He jiggled the nest slightly when I was ready to snap the picture -- and as you can see, a mouse jumped out of the hole in the nest! Woodland deermice often use birds' nests as winter homes. They build a roof on top of the nest to help protect them, and they sleep during the daytime and travel at night to find food. We had wakened this deermouse from his daytime sleep. The deermouse didn't go far. I think it returned to its home a little later. There was a deermouse sleeping in the nest a few days later when I returned again, and it probably was the same one. I didn't disturb it again. Return this slide, and put slide eighteen in the viewer. You will see a nest that you MAY disturb in the winter -- but one that you should not disturb in the summer.

One of my daughters and I were out hunting when we came upon this nest. Are you familiar with the ornery insects that build this kind of nest? The WHITE-FACED HORNETS will send you running if you bother their nest in the summer. But it is quite safe to look at their nests in the winter. These nests are made of a paper-like material the insects make from wood. The material is much like the paper that people make from wood pulp. You'll find that the inside of the nest is constructed in a very interesting way. If you can find one of these, take it home and slowly take it apart. You can get an idea of the kind of work the white-faced hornets put into building their nest. Return slide eighteen and put slide nineteen in the viewer.

Slide nineteen will help you understand another thing that winter's snow does for people -- especially people who like to see flowering bushes in the spring. Shown here are Forsythia bushes in bloom in the spring. Many people like to see the lovely yellow flowers of Forsythia bushes, and they plant the bushes around their homes and in their city parks. There is no snow in this picture, and you could ask: "What does this spring blooming bush have to do with winter snow?" All I'll say just now, is that the winter BEFORE this picture was taken, these Forsythia bushes were pretty well covered by snow during the coldest part of late winter. Return this slide, and put the last slide in the viewer.

Slide twenty shows the SAME Forsythia bushes that you saw in the last slide, but this picture was taken during a DIFFERENT SPRING. The spring this picture was taken, wasn't nearly as pretty because most of the Forsythia bushes in the entire city had few flowers! Do you see WHERE the flowers are on the bushes in this picture? Can you guess WHY the flower buds on the upper parts of the bushes didn't grow into flowers the spring this picture was taken?

The winter before this picture was taken, was a rather "low snow" winter. There was only a very thin blanket of snow on the ground during the coldest part of late winter. In fact, you can see about how high the snow was, by looking at how far up these bushes the flower buds did develop into flowers. The flower buds ABOVE THE FLOWER LINE didn't have a protective blanket of snow over them to protect them from the severe cold of late winter nights that year. The buds were exposed to sunny days. The sunny days caused the flower buds to start developing. Once they started to develop, their normal winter protection against severe cold was lost, and the buds frooze and died during very cold, clear nights. A good blanket of snow would have kept the buds from developing early, and it would have given them protection from severe cold -- much like a good blanket can protect you from cold air.

Winter snow also offers protection for many other plants too. Some winter animals use soft, deep snow to protect them from severely cold winter nightime temperatures. In the next winter lesson you'll see how winter snow can be useful to you in reading the footprint record you can find outdoors in the snow. If you are an old hand at reading wildlife tracks and other sign, the next lesson will be a review for you. If you're not an old hand at track reading, I'm sure you'll learn much about identifying and tracking winter wildlife.

Return slide twenty, and check to see that the slides are in the proper order for the next person. To rewind the tape, please push the STOP button, and then push the REWIND button. When the sound of the tape rewinding is finished, remember to push the stop button again. Don't forget to write today's date after your name in the lesson two column on the LESSON USE CHART. Goodby. Push the stop button now.

LESSON SCRIPTS

AUDIO-TAPED SCRIPT, WINTER LESSON NUMBER THREE

Hello. How are you today? This is the third and last winter lesson. It shouldn't be more than two weeks before all the members of your class have had a chance to visit this lesson. When they have, we'll take a winter field trip. I hope that you have already taken a few winter field trips yourself. In some areas there is a hard crust of snow on the ground now, and walking in the woodlands and fields is very easy for most children. I wear rather wide boots while walking on the snow crust. The wide boots help keep me from breaking through the crust.

This lesson is about animal SIGN. By the word "sign", I mean all the tracks, traces, and other evidence of activity of animals. Tracks in snow and mud, and signs of food gathering and eating are kinds of "sign." Evidence of food storing, of uneaten remains of food, and of droppings -- or waste materials -- are also wildlife sign. Evidence of nest and den building, and of preparation for mating seasons are other kinds of sign.

Did you see any "buck rub" bushes or trees last fall? Buck rubs are a kind of deer sign. Bucks, that is male deer, rub the velvet-like cover from their antlers in the early autumn, before the deer mating season later in the autumn. They do this by rubbing, scraping, and battering small bushes and small trees. This helps wear the velvet from their antlers and it peels some bark off the saplings, leaving scarred branches which are called the "buck rub." Deer hunters search for fresh buck rubs and for other evidence of buck deer activity in autumn. This helps them decide where to hunt later in the autumn. You can find buck rubs long after they were made. Even though new bark usually develops on the branches, the scars can be seen for many years.

Feathers and fur shed by wildlife are also signs of animals that live in an area or travel through the area. Some animals use urine markings or other odor producing markings to mark the edges of their territories. They often use such markings to leave a message for other members of their species, saying, "I've been here."

All the different kinds of wildlife sign can be used to figure out such things as: WHAT animals have been in an area, what they have been DOING, and about HOW MANY animals of different kinds live or travel through an area. Information you learned in the earlier winter lessons and in the wildlife ecology game should help you decide WHERE to look for signs of different kinds of winter wildlife.

If you can read the wildlife signs, you can play the detective role of the wildlife biologist. Wildlife biologists and other conservationists use evidence they find to help them understand the living habits and behaviors of wildlife species, and to make intelligent guesses -- or ESTIMATES -- of the numbers of individual animals in wildlife populations.

Put slide one in the viewer now, and look at some wildlife sign that is common to much of the United States. The tracks of this animal can be found in many places in the winter. This animal lives in our cities as well as in the countryside. It is the MOST HUNTED wildlife species in America. And still it continues to survive in "huntable" numbers in areas where disease or starvation haven't reduced the population to very low numbers. Do you now know what animal made this track? (pause)

It's method of traveling is by hopping or bounding, rather than by walking or running like you and I. Look at the bulletin board black and white photograph labeled number five. This is a closer view of tracks made by another member of the same species. If you still don't know what animal made these tracks -- or if you want to check your answer -- look at the hidden "flip" side of answer number five in front of you. (pause)

Our most hunted game animal is the cottontail rabbit. Return slide one and put slide two in the viewer now. Slide two is also a picture of the track of a cottontail rabbit. One set of four footprints is shown. Can you see that the prints made by the rabbit's four feet are not all the same size? Rabbits' back feet are a little longer than their front feet. And they leave a slightly larger print in mud and snow. Can you see the difference in footprint size in the black and white photo on the bulletin board?

Rabbits, like most animals that hop rather than walk, put their larger back feet down IN FRONT OF their front feet. And hence, their back footprints are found in front of their front footprints.

Sometime try hopping like a cottontail, a squirrel, or a deermouse. People are better designed for walking. But with a little practice you'd find you can touch your hands down on the ground, and swing your legs past and in front of your hands for the power stroke of the hopping process. I don't think you'll find hopping a very comfortable way to travel. But animals whose legs are designed like those of rabbits, squirrels, chipmunks, and mice, normally travel this way. They would find walking to be a difficult, if not impossible task.

Look at black and white photograph number three on the bulletin board. These tracks look much like the rabbit tracks in slide two and in black and white photograph number five. The animal that made the tracks in photo three is also a hopping animal. It, like the cottontail rabbit, puts its front feet down first and balances on them for a split second white its back feet swing slightly ahead of the two "close-together" front feet.

Do you know the name of the animal that made the tracks shown in photograph three? (pause) Check your answer. The squirrel that made these tracks was a Gray Squirrel -- the most common type of squirrel in northeastern United States.

Compare the squirrel tracks in photograph three and the rabbit tracks in photograph five. You'll see what I think is an easy way to tell squirrel tracks from rabbit tracks. Squirrels usually put their front feet down "side-by-side", as a pair. You can see that the small front feet squirrel tracks in photo three are side-by-side. But rabbits usually place one front foot down slightly ahead of the other front foot.

Can you see that the smaller, front footprints in photograph five are IN A LINE rather than side-by-side? Sometimes you'll find a cottontail rabbit track that resembles a squirrel track because the rabbit placed its front feet side-by-side occasionally. But most of the time rabbits place one front foot in a line in front of the other.

Another track clue can help you tell squirrel tracks from rabbit tracks too. Tree climbing animals, such as squirrels, usually have fairly long toenails -- or claws. Claw marks are commonly found as parts of squirrel tracks, but they are seldom seen in rabbit tracks. Claw marks are much easier to see in squirrel tracks in mud or shallow snow than they are in deep snow. Rabbits too have claws, but heavy fur on their feet usually make it difficult to see rabbit claw marks. Except when a rabbit is bounding at high speed with its toes spread far apart, claw marks are seldom seen in rabbit tracks.

Return color slide two and put slide three in the viewer. Let's look at the tracks of a different winter resident. What sort of animal track is shown in slide three? (pause) Its a bird of some sort, isn't it? These tracks were made by a ring-necked pheasant. Can you see the three FORWARD TOE or front toeprints in each track? If you look closely you may be able to see the print left by the smaller back toe in each track, too. From the track pattern left by the pheasant, can you tell whether the pheasant is a walking bird or a hopping bird? (pause) The Pheasant walks or runs when it travels on the ground -- much like you and I do, placing one foot down and then the other foot in front of the first.

While you have this slide in the viewer, look for a moment at bulletin board photograph number FOUR. Photograph four also shows some bird tracks. By comparing the size of the bird tracks with the size of the matchbook in photo four, you can see that the bird that made these tracks had feet much smaller than the feet of a pheasant. Not only was this bird smaller than a pheasant, but it TRAVELED in a different manner too. The bird tracks in photo four are in PAIRS, with the bird's left footprint beside its right footprint. How do you think this bird travels on the ground -- by walking or by hopping?

The small songbird that was eating the tiny weed seeds shown in photograph four, hopped. Not all smaller birds hop -- some, like starlings walk just as chickens and pheasants do. Others, like robins and sparrows, hop.

You can tell the direction the songbird was traveling in photo four, if you look for the single BACK toe print. Like pheasants, this songbird had but one back toe, and its print stands out in photograph four. The songbird traveled from the weeds, past the matchbook, toward the bottom of the picture. Look back at color slide number three in the viewer. Which direction did the pheasant travel in this picture? (pause) The three FRONT toeprints of the pheasant make it easy to tell which direction the pheasant was traveling. Return slide three and put slide four in the viewer.

Slide four will give you a review of some of the tracks you should be able to identify now. What animals made the tracks shown here? (pause) Two sets of pheasant tracks cross this slide. One pheasant traveled in a straight path. The other pheasant stopped and took a "jog" back a short way before going on its way. The second type of animal track on this slide, looks like tracks you've seen on the bulletin board and on earlier color slides. Can you tell which way the cottontail rabbit was traveling in this picture? (pause)

Look again at photograph five on the bulletin board. Remember that the larger back feet tracks are IN FRONT OF the sort of "lined up" front feet tracks. Can you see that the tracks in photo five lead toward the BOTTOM of the photograph? Likewise, the squirrel tracks in photograph THREE on the bulletin board lead past the bent over goldenrod plant, TOWARD your right. Now can you tell which way the rabbit tracks in color slide four lead? (pause) That's right, they lead UP the picture and to your left. Return this slide and put slide five in the viewer.

More cottontail rabbit sign is shown here. These rabbit droppings are sometimes called rabbit "pellets." Scientists call such undigested remains of food materials, SCAT. Finding large amounts of these pellet-shaped SCAT in an area is a pretty good indication of heavy use of the area by rabbits. Other plant eating animals produce pellet-like scat similar to rabbit pellets. Pellets of deer are commonly found in good deer habitats. Rabbit pellets are about the size of the fingernail on your little finger. Deer pellets are larger, usually closer in size to the fingernail on your thumb. The size and appearance of deer scat changes during the year, depending mostly on what the deer have been eating. Return slide five and put slide six in the viewer.

Slide six shows a pile of pellet-like scat of whitetailed deer, as it usually looks in the winter. The deer scat shown here looks quite dark in color -- almost black. And it is more smooth and shiny than the dull brownish-tan rabbit pellets you saw in the last slide.

The scat of foxes, muskrats, raccoons, mink, and other animals are often found outdoors. Careful investigation of these materials by scientists, helps us discover information about the eating habits of these animals. Remember how the coughed-up owl pellets containing hair and bones of voles and mice help tell us about the eating habits of owls? Return slide six and put slide seven in the viewer.

Slide seven was taken near the area where I took the last slide. There is a deer bed in this picture. It was used the night before I took this picture. I placed by packbasket near the deer bed so you could get an idea of the size of the deer bed. The deer that slept here that night bedded down in the open, in the middle of a large area where all the tree had been cut the previous summer. The deer's bed was almost completely surrounded by large brush piles. But it was unprotected from above, and the deer was exposed to the light snow that fell that night. Return slide seven and put slide eight in the viewer now.

Slide eight shows a single footprint track of a deer, at the edge of the deer bed you saw in the last slide. Can you see where the snow in the deer bed was melted by heat escaping from the deer's body? Single deer prints seem to me to resemble a valentine heart in shape. They look to me, like a heart that has been broken down the middle. The point of the heart points in the direction of travel of the deer. I followed this track for a few hundred yards, and found where its owner had been feeding on some unpicked apples in an old orchard. Then I lost the deer's trail among the tracks of a number of other deer. Return this slide and put slide nine in the viewer.

I placed one of my gloves in this picture to help you get an idea of the size of this animal's tracks. Can you guess what animal made the tracks? (pause) Was it a hopping animal or a walking animal? (pause) The paired tracks tell us it was a hopping animal. If you look carefully, you'll see a thin line between the footprints. This line is a tail track, left by the long thin tail of the Deermouse whose track you are looking at. Tail marks are usually -- but not always -- found between and slightly behind the paired footprints of deermice tracks.

Deermice often put their back feet down so close to their front feet that it takes careful inspection to see both back and front footprints in a set of their tracks. Look at bulletin board photograph number eight and you'll see the tracks of another hopping animal that puts its back feet almost in its front feet tracks. Can you guess the name of the animal that left the tracks shown in photograph number eight? (pause) Since there is little in the photograph to compare the tracks with in size, I expect that only the most experienced field trippers in your class can recognize these tracks. Check answer eight to see if your guess is correct. (pause) There is no tail mark in this Weasel track. The weasel's tail seldom leaves a mark in the snow. It is not like the thin tail of its prey, the deermouse. Return slide of the deermouse tracks and put slide ten in the viewer.

This hole in the snow is another wildlife sign. The hole, about as big around as a nickle, may have been made by a meadow vole, or it may have been made by a shrew. You should know something about the lives of meadow voles from the winter wildlife game, "How Was Your Winter." I hope you've had some opportunities to play the game by now.

Shrews are tiny mousy-looking animals with rather long noses and tiny eyes. They live lives much different from voles. Shrews are predators like weasels. Shrews prey mostly on insects during the warmer months -- and they'll eat insects in the winter if they can find them in the upper layers of soil or in logs and stumps. Shrews have huge apetites, and will eat most any small animal they can kill, including voles. Like voles, shrews do much of their eating and traveling, under the snow in the winter. Both shrews and voles leave holes in the snow where they enter and leave the protection of the snow. I could find no tracks near the hole shown here, and it is almost impossible to identify tracks under the snow in the winding runways made by shrews and voles.

Look at bulletin board photograph number TWO for a moment. This shows that an animal came out from under the snow in the lower part of this photograph. It traveled a short distance on top of the snow, and then entered the snow again. The footprint tracks near the cattail fruit appeared to be meadow vole tracks. But alittle further on, there were marks that looked a little like tail marks. The short tail of the meadow vole almost NEVER leaves a mark in the snow -- whereas shrews, whose footprints are only slightly different from the tiny baby-like "hand prints" of voles, USUALLY leave a tail mark. If you've checked the answer board you've found that I've called the sign in photograph two, the tracks of a meadow vole. Most of the animal sign indicates that they are.

Return slide ten and put slide eleven in the viewer now. This slide was taken near the place I took bulletin board photo number four. And it is also a picture of some bird sign. I've included this slide to show you some songbird sign that is not simply footprint tracks or remains of uneaten fruit and seed materials. Shown here are prints of the wing and tail feathers of some birds. Can you see the groups of lines made by the birds' feathers? (pause) Return slide eleven and put slide twelve in the viewer.

The footprint path shown here, looked from a distance like that of a wandering, hunting fox. The animal that made this track, WALKS rather than hops. And it walks in a fairly straight line, much like a fox that is wandering here and there to inspect other animal sign. The animal also puts its back feet down almost directly on top of the prints made by its front feet -- much as a fox does. This animal was NOT A FOX, but like a fox, it was hunting when it made these tracks. Return slide twelve and put slide thirteen in the viewer, to see a closer slide of this animal's tracks.

Do you recognize these tracks? (pause) If these rather "round" looking footprints were the size of a baseball, I'd say they were the tracks of a Bobcat. Even larger tracks like this, found in North America, are made by Mountain Lions -- or Cougars. But this is the track of a smaller cat. This is the track of a tame, or domestic house cat.

You know that house cats have sharp claws. Do you see any claw prints in this picture? (pause) You usually won't see any claw prints in the tracks of almost all members of the cat family. Most kinds of cats can withdraw their claws into small sheaths on their paws. They usually don't extend their claws unless they are needed for climbing or for catching prey. Return slide twelve and put slide thirteen in the viewer now.

If you look closely at this slide, you can see the claw prints in the tracks shown here. The animal that made these prints is not able to withdraw its claws and claw marks are usually seen in the prints of this animal and the prints of others of its family. Do you know what animal made these tracks? (pause) These were made by a dog. They are similar in shape to tracks made by coyotes and wolves, and the prints made by some small dogs look much like those made by foxes.

Dogs often travel in the fields and woods in the winter. Their hunting instinct can get them in trouble at this time of the year. Some tame dogs seem to enjoy running and killing deer in the late winter. They find it easy to catch deer on hard crusted snow. Often the snow crust is strong enough to support the weight of a running dog, but not strong enough to support the sharp hooves of a deer. Under these snow conditions, fleeing deer can't travel very fast, and are not able to outrun groups of dogs as they usually can under different ground conditions. If you have a dog, don't let it run loose during times when deep snow is covered by a hard icy crust. Return slide fourteen and put slide fifteen in the viewer.

You've looked at tracks like this earlier in this lesson. The oak leaf above this set of four footprints, should give you an idea of the size of the animal that made these tracks. This woodland animal was hopping along on a fairly thin layer of new snow, and the marks of this animals footpads and claws are easy to see in this picture. Look again at bulletin board photograph number THREE to see the same animal's prints in deeper snow. (pause) In photograph three the squirrel was hopping to your right. In which direction was it hopping in slide fifteen? (pause) Return slide fifteen and put slide sixteen in the viewer now.

Shown here are squirrel tracks in very deep snow. Can you see where this squirrel's rump dragged in the snow? It left a print between the back footprints each time the squirrel hopped. This squirrel had hopped in almost a straight path away from the place where I took this picture. Return slide sixteen and put slide seventeen in the viewer.

In slide seventeen there is another gray squirrel's sign in deep fresh snow. What does this sign tell you about the squirrel's activity? Look near the bottom of this picture. Can you see where the squirrel dug a hole in the snow? (pause) Do you know WHY it dug down into the snow to the ground? (pause) Return slide seventeen and put slide eighteen in the viewer.

In slide eighteen there is a path of tracks that BEGIN or start from a hole in the snow. These are not squirrel tracks, and the hole didn't go all the way down to the ground. These tracks did not end at the base of a tree either. They made a winding path through the woods and then came to an end in the middle of a small clearing! If this picture showed a closer view of the tracks, you would see that they look something like the pheasant tracks you saw earlier -- except these footprints are slightly smaller, spaced much closer together, and each toe print looks a little thicker or wider than pheasant toe prints.

The story told to me by this RUFFED GROUSE sign early that morning was this: The grouse had slept in the snow the night before. It then shook off its snow blanket, and walked in its usual slow searching manner, wandering here and there, and then took to flight from the spot where I last saw its tracks in the middle of the small clearing. This ruffed grouse, like others, had no trouble walking on top of the new light snow. Ruffed grouse grow many tiny scale-like things along their toes, in preparation for winter snow. The rows of scale-like things make a fringe along both sides of each toe. These fringes give the effect of widening each toe, and they serve as natural snowshoes for grouse in the winter. The scales don't last through the summer, and have to be regrown each fall for the next winter. If your father bagged some grouse during the latter part of the hunting season last fall, you may have noticed the "built-in snowshoes." Return slide eighteen and put slide nineteen in the viewer.

This track began from a hole in the ice on a drainage ditch on one side of the road. It traveled across the road and went into another ice hole in a drainage ditch on the other side of the road. This hole is shown in the upper part of this picture. I placed one of my gloves beside this hole so you could get an idea of the size of the hole. To see tracks that tell a similar story, look at bulletin board photograph number SIX. Here the tracks began at a hole in the ice on a pond. They travel toward the cattail plants shown in the lower part of photograph six. Photograph SEVEN shows a close-up view of the tracks. Was this a walking or a hopping animal? (pause)

The animal that crawled out of the water in each of these situations left a thin tail mark in his tracks. Have you guessed what common water animal made the tracks in slide nineteen and in black and white photographs six and seven? (pause) Check your answer on the bulletin board answer sign, to see if you were correct. (pause)

Another common sign of muskrats are the piles of roots, mud, and plant stems that make up the winter homes of many muskrats in marshes and swampy areas. Muskrats also live in dens along the banks of streams. The entrances to these dens, like the entrances to the mud and plant material lodge-like homes, are under water. Return slide nineteen and put slide twenty in the viewer.

The sign seen in this last slide is becoming more and more common in the fields and forests of northern United States and Canada. Did you recognize these snowmobile tracks? (pause) These tracks also tell stories to an outdoor detective. Many tell of hours of enjoyment in the outdoors. Some tell of rescue missions in snowed-in areas after blizzards. Some tell of ice-fishing trips to hard-to-get-to lakes. I think snowmobiles have opened new doors to enjoyable winter recreation for many people who never traveled outdoors in the winter before in our fields and forests.

But some snowmobile tracks tell stories that aren't so nice. Some tell of chasing winter wildlife -- often resulting in the death of the wildlife because of exhaustion and fright. Some tell of inconsiderate people trespassing on other peoples' property, and often times running over and destroying shrubs and flower beds. Some tell of noisy trips down streets at night, inconsiderately waking people from needed sleep.

The most tragic stories told by snowmobile tracks are stories of machines and their drivers breaking through the ice on deep lakes, or of being hit by cars or trains -- usually because of "show-off" or careless habits of the drivers. Snowmobiles can be used in very worthwhile ways and can bring countless hours of excitment and pleasure -- but care and consideration for others must be displayed by snowmobilers.

Return slide twenty now, and check to see if the slides are in the proper order for the next person. After you have rewound the tape for the next person, take a minute and review the winter sign photographs on the bulletin board. Nothing was said of picture number ONE during this lesson. The large woodpecker -- the Pileated Woodpecker -- that makes these "squarish" looking holes, is a spectacular sight to see in the outdoors.

Members of this species are large -- about the size of crows -- and they have large lovely bright red crests on their heads. Their sound is "large" too. I've been instantly awakened by a pileated woodpecker drumming on a dead tree early in the morning near a campsite. Heard through the walls of my tent, their drumming sounded much like a machine gun. Pileated woodpeckers are not as rare as their almost extinct relatives, the Ivory-billed Woodpeckers, but they are not a common sight in our woodlands. A view of a pileated woodpecker is worth many hours of searching to most people who are interested in wildlife. Maybe we'll be lucky enough to see one on our winter field trip. Remember to write today's date by your name on the student use chart, and then rewind the tape for the next person. Goodby.

LESSON SCRIPTS

AUDIO-TAPED SCRIPT, SPRING LESSON NUMBER ONE

Hello. I hope you are feeling fine today. This is the first of three spring environmental education lessons I have prepared for you, to help you get ready for a spring field trip.

Of all the seasons, spring is for many people, the most enjoyable season to be outdoors. After a long winter, it is very difficult to stay indoors on warm spring days. Bird songs early in the morning, frog choruses on warm evenings, the smell of warming soil and of spring flowers, and the sight of returning waterfowl and of new green leaves everywhere, call many people outside.

Spring is a time of increased activity for all living things. It is a time of RENEWED GROWTH for trees, bushes, many kinds of ferns, some fungi, and other plants that live from year to year. Spring is a time of NEW GROWTH for many other plants, and a time of NEW GROWTH -- or BIRTH -- for many kinds of outdoor animals. Both NEW GROWTH and RENEWED GROWTH require much energy. Increased sunlight due to longer daylength in the spring, provides energy for plants. And both the new growth and the renewed growth of living things provide food energy for animals. The renewed growth of many plants, and the birth of many animals provide food -- and hence they provide food energy -- for many other newly born animals. Put slide one in the viewer and you'll see the results of the RENEWED GROWTH of some plants that spent the winter underground as bulbs.

Do you know a name for these spring flowering plants? (pause) The renewed growth of tulips in someone's yard or garden, is a sure sign that spring is upon us. When growing conditions become favorable, tulips, like many other plants that live from year to year, use the food energy stored in underground parts, and they grow again. They react to the increased sunlight, the warm rains, and the warm soil.

Do you know why the weather is warmer in the spring? (pause) Spring weather, like all the seasons with their characteristic kinds of weather, is caused by the position of the earth in its orbit around the sun. Because of the tilt of the earth's axis, the northern half of the earth now gets more daytime each day. The path of the sun as it crosses the northern hemisphere skies, has become longer that it was in the late fall and winter. Have you noticed that the sun rises much earlier and sets much later now than it did last fall and winter? Return slide one and put slide two in the viewer.

This spring flowering plant is a Redbud tree. It also began active growth AGAIN with the longer days and warmer weather of spring. You won't see any leaves on this tree, because spring conditions first trigger the growth of Redbud trees' FLOWER BUDS. Later the leaf buds grow. Many spring flowering trees grow their flowers before their new branches and leaves develop. The flower buds, like the buds that grow into new twigs with leaves, were on the tree all winter of course. You know from your field trips that buds are formed before winter begins. They appear in late spring and early summer, and grow all summer before they open the following spring.

Do you know what causes the buds to open the following spring and resume active growth? (pause) Yes indeed, the days are longer, the weather is warm again, and moving sap in the trees brings a new supply of water, food, and other chemical substances to the buds.

The speed at which buds and other plant parts grow depends on how warm the weather is. The sun becomes much more powerful in heating the earth in the spring, even though the sun is not closer to the earth in the spring and summer. Because of the tilt of the earth, the sun travels much higher overhead in our northern half of the earth now. Have you noticed how high the sun now seems at midday? The sun's rays now beat down more directly -- much more directly than they did last winter -- and the sunlight is much more effective now in heating the earth.

I've got a hunch that you've told your mother more than once already this spring, that it was too warm outside to wear the jacket or sweater that she thought you needed outside on early spring days. (pause) The sun, rising earlier and appearing higher in the sky now, does indeed heat our earth much more rapidly now. Return slide two and put slide three in the viewer.

I took this picture in very early spring. This red maple tree is one of the first trees in which flower bud growth begans again in the spring. If we get a few warm days in late March, active growth begins again in red maple trees' flower buds. Do you remember from the winter lessons, that these buds are an excellent source of food for deer and other animals in the winter? The buds had food energy stored in them, but temperatures higher than our winter temperatures, and a daylength longer than our winter daylengths, are necessary before red maple buds will resume growth. Can you see that there are no new leaves on the tree in this picture? Red maples, like redbud trees and many other flowering trees, began flower development before twig and leaf growth in the spring. Return this slide and put slide four in the viewer. In slide four you'll see a much closer view of red maple flowers.

These red maple flowers are fully grown. They aren't very big, and few people would think of picking them to put in a flower arrangement or a bouquet. But I think they are pretty even though they are very small. Take a close look at some red maple flowers this spring if you haven't done so before. One some flowers you will see tiny pairs of winged maple fruits starting to develop. By the way, sugar maple trees develop their flowers and fruits later in the growing season. If you look under many sugar maple trees at this time of the year, you may find hundreds of last year's seeds, growing into tiny sugar maple tree seedlings. Return slide four and put slide five in the viewer now.

Slide five shows both flowers that have grown from flower buds, and leaf buds that are just beginning to grow again. The leaf buds, which develop into new twigs with new leaves and new buds on them, are the sharp pointed things that look like growing buds. This is a branch of an American Elm tree. The clusters of dangling greenish things are the flowers and developing fruits. I think these elm tree flowers are even less "flowery" looking than the red maple flowers. It is probably their green color that makes it alittle difficult to think of them as flowers. I suppose we are used to thinking of flowers as large and colorful things, like the flowers of rose bushes or lily plants.

Most people notice elm tree flowers and fruits only when they sweep them off their sidewalks or out of rain gutters after a heavy spring rain. Rains in late April bring thousands of them down on streets and sidewalks. In towns and cities where the Dutch Elm Disease hasn't killed most of the elm trees, you can often find a carpet of the tiny green or tan elm fruits. They are almost circular and very flat in shape. They are smaller around than a penny, and are much thinner. But even though each one is very small, they sometimes are found by the thousands, forming a layer on streets and walks.

Those that land in protected places that provide the right amount of water, and loose soil with the right chemicals, will grow into elm tree seedlings later in the spring. But most of them end up as good fertilizer, because most will die and decay on the ground. Return slide five and put slide six in the viewer.

Slide six shows another example of growth beginning again -- that is, RENEWED growth -- in the spring. During the winter a small bud was nestled between the four small pine cones on the end of this pine branch. Now with the more favorable growing conditions of spring, the bud shown here grew into a "candle-like" branch that looks a little like a light-colored porcupine with a tiny reddish cone on its top. As this candle-like branch continues to grow, each of the spiny things will develop into a pair of long, green, pine needles. If you break open a "spine-like" thing on a pine "candle", you will find that each spine is a tiny pair of developing pine needles covered with a paper covering.

The entire candle grows longer and becomes a new pine branch covered with its newly developed pine needles. The reddish pollen cone at the tip of the candle, also grows larger. In time it releases millions of powdery grains of yellow pine pollen. Seed cones, like the group of four cones you can see in this slide, also grow larger during the spring and summer, and the seeds inside them mature. Return this slide and put slide seven in the viewer.

Shown here is an example of what I call NEW GROWTH of spring, rather than the REGROWTH I've been talking about. This baby cottontail rabbit wasn't around last summer, fall, and winter. This actively growing "bundle of life" began life this spring as some very tiny cells from the parent rabbits. Its true of course that the parent rabbits were alive last year, but this baby cottontail, like other spring animal babies and sort of like spring plants that grow from the previous autumn's seeds, started life as a brand new individual in the spring.

I love to see wildlife babies like this cottontail baby, in the spring. But I learned long ago that I shouldn't handle them. They are well designed to take care of themselves -- without me -- even without their mothers, when they are as old as this cottontail rabbit. When a person captures a wildlife baby in the spring, whether its a mammal like this cottontail, or a baby bird, they usually do the animal more HARM than good! Wildlife babies are seldom abandoned by their mothers before they are ready to be left to care for themselves. When you see wildlife babies that appear to have been forgotten, they are either ready to be out on their own, or their mother or both parents are hiding nearby, hoping that you will go away so they can get back to caring for their offspring.

Baby animals that still need their parents' care, need care OFTEN. You should never take too long to look over a wildlife baby. Wildlife babies that are young enough to require their mothers' care, need almost constant feeding. Few people have the time, the energy, and the "know-how" to give very young wildlife babies the kind of care they need to stay alive. (pause) Return this slide and put slide eight in the viewer.

Here is a newly born baby deer. It is quite well camoflaged, and is hidden in the forest undergrowth. This fawn wasn't very old when I came close to stepping on it one spring morning. It didn't stir during the time it took me to take its picture. Its mother, I discovered a few moments later, was only a few yards away. When I had taken this picture, I startled the fawn into rising, and it wobbled on its shaky legs toward its mother. I quickly left by another path so as not to disturb them further. If you haven't spotted the hidden fawn in this picture yet, its tiny spotted form can be seen almost in the center of the picture, under the lily flower. (pause) Return slide eight, and put slide nine in the viewer now.

Here is something you CAN DO for spring wildlife babies. Bird houses, sometimes called "bird nesting boxes," can provide nesting places for a variety of birds. Bird houses are very useful in areas where people have cut down dead trees that could have provided nesting places in holes and in hollowed out tree limbs. In places where farmers have replaced wooden fence posts with metal fence posts, bird houses can be very useful in providing nesting places for some kinds of birds that used to use holes in older wooden posts for nesting sites.

Different birds prefer different house sizes and different doorway sizes. A nesting box for a house wren, for example, should have a door about as big around as a twenty-five cent coin -- that is, a quarter. Bird houses for tree swallows and bluebirds should have doorways a little larger. They should be about one and one half inches in diameter. If you would like to build some bird nesting boxes, your science teacher may be able to furnish you with a list of birdhouse sizes, preferred by some of the birds that nest in this area. Return slide nine and put slide ten in the viewer now.

You know the name of this adult bird I'm sure. Robins don't often build nests in bird houses. They do build their heavy mud, grass, and straw nests on platforms quite often. They prefer something sturdy to build on. If you would like robins to nest around your home, and there are no trees or bushes with sturdy enough branches to support their heavy mud nests, you might build a nesting platform and get someone to help you attach it under a protective eave on the side of your home or garage. A nesting platform for robins should be at least six or eight inches wide and deep. I think you would enjoy watching the efforts the parent robins make in feeding their young. Return slide ten and put slide eleven in the viewer.

In the last slide you saw a parent bird with its babies. Shown here are some Mallard ducks -- a pair of adult birds -- before their ducklings hatched. In fact, you are seeing a picture taken before a nesting site was chosen, a nest or nests were built, and before any eggs were laid by the female duck. Courtship, that is, the selection of a mate, and mating, take place before nesting begins. For many mammals and for most birds, courtship and mating take place early in the spring.

Without mates, animals can not produce youngsters to replace members of the population that die each year. There can be much competition between animals of the same species for mates in the spring. I'm sure you've heard stories about buck deer fighting for does during the deer mating season in the fall. You may have seen some animals battle for mates. I've seen drake mallards have some fairly good squabbles over female mallards.

But fighting for a mate requires much energy -- its not easy work. The building of nests and the protection and feeding of youngsters, done by many species of animals, also requires much energy. Many kinds of animals -- mostly birds -- have developed courtship behaviors, or ways of mate selection, that DON'T require fighting. Most of these non-fighting courtship behaviors save the animals energy -- energy that can be put to use in providing for the young.

Some bird species have developed non-fighting courtship behaviors that also result in providing SPACE for nests and SPACE for food gathering for the feeding of baby birds later on! Return this slide of the mallards, and put slide twelve in the viewer for a look at one type of non-fighting courtship and SPACE defending behavior.

The silhouette you can see against the early morning sky, is the silhouette of a male field sparrow, perched on a tall weed, singing in the very early morning hours in mid-spring. A short distance down a country road from this field sparrow there was a male Red-winged Blackbird, singing his song from a fence post. All along the roadside, and in the thickets and the woodlots that spring morning, male birds of many different species were singing. They were singing, instead of fighting!

Each male field sparrow was singing a song to other MALE FIELD SPARROWS, and the words of the song were, "Stay away from my territory!" The song gave the message, "The area around where I am singing, is MY territory, and my future mate and I will raise our young here!" Male red-winged blackbirds, perched on cattail stocks, telephone wires, and fence posts, were spreading their feathers and singing, "Stay away from MY territory!" The song of the field sparrow didn't frighten the male red-wings. And the red-wings' songs didn't frighten the male field sparrow. They can nest quite close together because red-wings and field sparrows don't need the same kinds of nesting materials nor the same kinds of FOODS for their young.

In the woodlots male woodpeckers were, with their songs and with their drumming on dead trees, saying, "This is my territory" to other male woodpeckers. In the thickets male catbirds were warning other male catbirds to stay away from the edges of their territories.

All the bird songs and noises sounded quite lovely to me, as they may well have sounded to female birds. But the reason for the lovely springtime music was not because the singing birds were necessarily "happy." Rather, their songs and noises were mostly WARNINGS. They were warnings to other males of their species to be prepared for a battle if they ventured too close to the territories the singers had selected.

The songs and noises are usually enough warning to prevent actual fighting between male birds, even though males that lack good courtship or nesting territories do challenge males that have good territories. When he is challenged, the male with a territory will chase an intruding male if he gets too close. But seldom will the two male birds do much more than have a short flying chase. In almost all challenges, the bird that had first claim on a territory wins the dispute. Having a territory to sing about seems to give a male bird some kind of psychological advantage over males of his species that don't have territories.

Male birds that claim territories in places that are good nesting habitats for their species, usually are successful in winning a mate! Those that don't get territories, usually don't mate, and therefore they don't produce any offspring.

When a female bird approaches a male at an edge of his territory, he usually lets her fly into the territory. Female birds usually react differently to the spring territorial songs of the male birds. The male birds can recognize the different behavior, and they will usually not chase females away when one enters their territories. Return this slide of the singing field sparrow, and put slide number thirteen in the viewer.

In the center of slide thirteen you can see three red-winged blackbird eggs. This nest was made of cattail leaves and grasses, woven into a bowl-like shape, and suspended above the marshy ground in a clump of iris plants. About eighty feet in each direction around this nest, there were four other red-wing nests. They were, like this one, fairly hard to see, being hidden in clumps of cattails, marsh rushes, and willow bushes.

The marshy area where I took this photograph, was an excellent environment for raising young red-wings, and the territories were spaced quite close together. In less desirable red-wing habitats, that is in places where there is not as much protective cover and food for feeding the young red-wings, the nests will be found spaced much farther apart. Red-wings usually establish territories and nest in areas where they can get the kinds of food needed for their young and where they can get the kinds of nesting materials they use.

Birds of other kinds -- and other kinds of animals, too -- raise their young in the best habitats they can find for their species. The babies in the picture on the bulletin board are raised in many different kinds of places. Each is raised in the habitat that provides the kind of food and protection needed by its species. If the right kind of habitat is not available for an animal, it can not raise its young.

One of the main reasons why some animals have become extinct, and why many others are in danger of becoming extinct, is that we people have destroyed all or most of their nesting and offspring rearing habitats. Our marshlands, especially the marsh lands at the edges of our oceans, are places where many forms of wildlife begin life and grow up. We can't afford to pollute or otherwise destroy any more of these important animal nurseries. Return slide thirteen and put slide fourteen in the viewer.

Slide fourteen shows a mother red-wing feeding a young bird. The female red-wing is neither "red-winged" nor "black" is she? The female red-wing is a brownish bird with long brown streaks on her white undersides. You'll see a male red-winged blackbird in the next slide. The male isn't as camoflaged looking as the female. The male red-wing's colors, like the colors and patterns of MOST male birds, are brighter.

Male birds of many species have feathers that are bright and easily seen. Do you remember how different the male and the female mallard ducks looked in slide eleven? In bird species where the male is much more colorful than the female, often only the female bird cares for the eggs and the baby birds. The males' bright colors are useful in drawing the attention of other birds of his species when males are warning other males away from their territories and attracting females.

But the bright colors of many male birds make them easier targets than the duller-looking females, when predatory animals are looking for a bird for food. Return slide fourteen and put the last slide in the viewer. You will see a fairly rare sight in slide fifteen.

In slide fifteen a male red-winged blackbird is shown carrying some food for a young bird. You can see that the male red-wing does have bright red patches on his wings, and is glossy black in color. Sometimes you will find male red-wings joining with females in the feeding of their young, but MOST male red-wings, like the males of many species of birds, don't help in the care of the eggs and the feeding of the young. Male mallard ducks, for example, abandon the females after the courting period. However, Canada Geese males -- or "ganders" -- remain with their mates for their entire lives. Each nesting season, both the gander and the female, or "goose", defend their territory together. They build the nest, care for the eggs, and later defend their goselings together.

Return slide fifteen and listen for a few minutes to the territorial songs of some male birds you can hear in this area this spring while on a field trip or a hike. Most of the spring bird songs you hear will be the songs of male birds. Female birds of most species can, and do make some sounds, but most female birds can't sing the songs we hear so often on warm spring mornings and evenings.

(Recorded songs of the following birds, each identified and of approximately forty seconds in duration:

1. Red-winged Blackbird.
2. House Wren
3. Field Sparrow
4. Robin
5. Catbird
6. Flicker Woodpecker
7. Phoebe

In the next lesson you'll learn about some other kinds of animals that sing in the spring, and you'll learn some things about them that I think will make a spring field trip very interesting. Please be certain that the slides are in the proper order for the next person, and don't forget to rewind the tape. Write today's date by your name on the student lesson use chart.

Goodby until our next lesson.

LESSON SCRIPTS

AUDIO-TAPED SCRIPT, SPRING LESSON NUMBER TWO

Hello. How are you today? This second spring environmental education lesson is about some of the animals that you couldn't find in this area in the winter, but that you can find outdoors now. The lesson is about the springtime behavior of some of the amphibians and reptiles of North America.

Amphibians and reptiles spend the winter months in hibernation in this area. You can find them outdoors now that the weather is warmer. Early spring and mid-spring are excellent times to study amphibians and reptiles outdoors. Many kinds can be easily found, before the new growth and regrowth of plants is completed. In late spring and summer, plant foliage is often so thick in places that snakes, frogs, and salamanders inhabit, that they often seem to disappear before one can get a good look at them.

There is another reason why this time of the year is a good time to observe amphibians and reptiles. In early spring, many kinds of them can be found fairly close together as they gather together during the mating season. Most kinds of frogs and toads, and some kinds of salamanders gather near ponds and in marshy areas. They mate and lay eggs in these wet areas. Many of the frogs and toads, like the tiny spring peeper in the photograph on the bulletin board, sing loudly at this time of the year. Their singing on warm spring evenings is a welcome sound to most people. Its a pretty sure sign that spring has arrived.

There are two books in the booth for this lesson. Find the book titled, "Pond Life". Open the pond life book to page 134, and while I play some spring peeper music, read what the authors wrote about spring peepers on page 134. First you'll hear a single spring peeper. (Sixty seconds of spring peeper mating calls, starting with the call of a single peeper, followed by a spring peeper chorus, and ending with the call of a single peeper again.)

Did you read that the singing of spring peepers is done only by MALE frogs? The fact that only the male spring peepers sing, may have reminded you of springtime songbird singing, where the singing is also done only by the males. Unlike singing done by territorial birds, the singing of spring peepers and of other singing amphibians, is not meant to warn other males to stay away from a courting or nesting territory. Spring peepers and other amphibians don't defend nesting territories, because they don't build nests or care for their young. Like the songs of territorial birds, the songs of frogs and toads do attract females to places where mating takes place and where living conditions are right for the early growth of the offspring.

Female toads and frogs are attracted to the wet areas from which the male toads and frogs sing. And these wet areas provide the shallow, standing water necessary for the early development of toad and frog eggs. Put slide number one in the viewer now, and see another springtime singing amphibian.

This fellow, with his bubble-like throat, was in the process of singing when a wildlife photographer took his picture. Shown here is a male American Toad. Pick up the book, "Reptiles and Amphibians", and turn to page 122. On the top of page 122 you'll find another picture of an American Toad. (pause) Also look at the Fowlers Toad, shown singing in a picture on the bottom of page 122. While you are looking at these and at other toads, listen to the shrill mating song of the male American Toad. (Forty-five seconds of American Toad singing.)

Both spring peepers and American toads -- and most other kinds of frogs and toads -- sing their mating calls from the edges of ponds or shallow pools. The eggs of most frogs and toads must be laid in a pool, pond, or puddle, if the eggs are to survive. Return slide one and put slide two in the viewer.

In slide two you can see a female toad, laying her eggs in two long strings. The darker colored and smaller sized male is clasping the female tightly with his front legs. The male's thumbs are enlarged during the mating season, and the female responds to the pressure of the male's thumbs and forelegs. When she is squeezed, she lays two jelly-like strings of eggs, as shemoves through the shallow water with the smaller male clasping her sides. If you catch a female toad that is still carrying her eggs, you can sometimes cause the same response by squeezing her a little, just behind her front legs.

The male fertilizes the eggs by depositing sperm on them while they are being laid. A pair of egg strings, each with as many as one hundred eggs, are sometimes laid in one place before the female toad moves a short distance to lay more eggs. A single female American toad can lay as many as ten thousand eggs during the spring! What do you suppose the earth would look like if all the eggs laid by each female toad, grew up to become adult toads? (pause) I expect that we would be more than knee deep in toads.

Very few of each pair of toads' eggs do result in adult toads. Most of them provide food for other living things, either while they are eggs, or later when they are tadpoles or young toads. Those that are laid in poor places, never develop beyond the egg stage. These provide food energy for decay organisms such as bacteria and fungi. Return slide two and put slide three in the viewer.

Shown in slide three are the soft, jelly-like egg masses of some other amphibians. The mass of eggs attached to an oak leaf were laid by a female spotted salamander -- one of the most attractive looking salamanders, I think. A colored slide of the spotted salamander will be used later in this lesson. The darker, more dense-looking mass of eggs, are the eggs of s small frog called the wood frog. These look darker than the salamander eggs because the frog's eggs don't have as much clear jelly-like material around each egg. If you find masses of frog, toad, or salamander eggs, why not take a few home in some of the water you found them in, and watch them develop into tadpoles?

Don't take more than a few of each kind though. Over crowding can kill amphibian eggs. Each developing egg needs quite a bit of oxygen if the embryo inside the egg is to grow into a tadpole. In order to get enough oxygen, each egg needs quite a bit of oxygen-rich pond or marsh water.

You should put only a dozen or so eggs in a shallow container of water. If you put many more than a dozen in a dish the size of a margarine dish, they won't get enough oxygen and they all will die. I would also recommend that you keep the dish of frog, toad, or salamander eggs out of direct sunlight. Its also a good idea to keep dirt and plant material out of the dish while the tiny embryos in the eggs are developing. The embryos don't need plant material for food until later, because they have a supply of food material with them as part of the egg. Plant material and other debris in the water is not only NOT NEEDED as food during the early growing stages, but it usually starts to decay in the water, and this takes oxygen from the water. The bacteria and fungi that cause materials to decay, use much of the oxygen in the water, and this takes needed oxygen away from the developing embryos.

So keep FEW eggs in clean pond or marsh water, in a shallow dish or pan, and you should be able to enjoy the interesting experience of seeing the early development of amphibian embryos. Return slide three and put slide four in the viewer.

Slide four is a very close-up view of a tiny toad tadpole. This tadpole wasn't as long as your thumb nail when I took this picture. In order that you could get an enlarged view of it, I made the tadpole look bigger by using a special camera lens . Can you see in this view that the tadpole's hind legs had already developed? I raised this tadpole, and others like it, in pond water in containers made from well-washed milk cartons. I kept them only long enough to get some photographs of them in various stages of their development. Then I let them go in the pond where I had found the eggs. Return slide four and put slide five in the viewer.

Slide five shows another toad tadpole. This one is about a week older than the one you saw in the last slide. This picture is also an enlarged -- or magnified -- view. Although this toad tadpole had all four legs, its tail was about the same size it was when the tadpole had only its hind legs. It still used its tail to help propel it about its watery environment in search of food.

When tadpoles are free of their jelly-like egg material, they do require FOOD from their environment. Often the tiny greenish algae cells common in pond and marsh water provide enough food for the very young frog and toad tadpoles. Other pond plants are also eaten by growing frog and toad tadpoles. If you are raising some at home or at school, you should add fresh pond water with small amounts of pond plants to your tadpole rearing pans every few days. I've found that a few tiny pieces of cooked lettuce and small amounts of fish food -- the kinds of fish food used for guppies, goldfish, and the like -- can also be used for feeding frog and toad tadpoles.

Don't add much lettuce or fishfood though, because that which isn't quickly eaten will soon start to decay. Decaying food can result in too little oxygen for the tadpoles. Natural pond plants will usually stay alive longer in water if you add fresh pond water now and then,and clean out decaying debris. Living pond plants will add oxygen to the water as they use light,water, and carbon dioxide to make food.

Salamander tadpoles require slightly different treatment -- because they eat a different sort of food. Salamander tadpoles are PREDATORS, like adult salamanders, frogs, and toads. They eat tiny animals. During the first weeks of their lives, after breaking out of their jelly-like cases, salamander tadpoles eat tiny, almost microscopic pond animals.

Pick up the pond life book and turn to pages 89 and 90 to see magnified pictures of some of these tiny pond animals. Most of the pond animals on pages 89 and 90 are not much larger than the "period" punctuation mark you see at the end of each sentence. Some are larger. The fairy shrimp and tadpole shrimp that you can see on the top of page 89, grow to almost an inch in length.

When salamander tadpoles get a little larger, they catch and eat quite a variety of larger pond insects and other animals. Thumb through pages 97 to 113 for a moment. You'll see quite a number of other pond animals -- mostly insect larvae and insect nymphs -- that growing salamanders catch and eat. (pause)

Do you know how to tell a salamander tadpole from frog or toad tadpoles? To see a fairly good drawing of a tiger salamander tadpole, turn to page 129 in the pond life book. On the top of page 129, you'll find pictures that compare the eggs, tadpoles -- sometimes called "larvae" -- and the adults, of the common leopard frog and the tiger salamander. (pause)

Can you see that the tadpoles -- or larvae -- of the two are different in shape? (pause) When frog, toad, and salamander tadpoles are younger than they are in the picture on page 129, they look very much alike. But if you look carefully at the heads of tiny tadpoles, you will see tiny feathery things projecting from the sides of salamander tadpole heads, even when they are very young. Some of these feather-like or finger-like projections are things that help the salamander tadpole keep its balance. But most of the projections are GILLS. They are outside or external gills -- like the gills shown in red on the neck of the tiger salamander larva on page 129. Frog tadpoles and toad tadpoles have inside, or internal gills. They don't look as "whiskery" as salamander tadpoles.

If you are going to watch some salamander tadpoles grow in a dish at home or at school, I suggest that you provide them with fresh pond water and pond weeds quite often. There will usually be enough pond animals living on and around the pond weeds for the salamanders tadpoles to live on. If they don't get enough food, they will become cannibalistic and attack each other. They will nibble at each others gills and feet if they don't have sufficient food. Return slide five of the toad tadpole, and put slide six in the viewer now.

Slide six shows an adult spotted salamander. You saw eggs of this species of salamander in slide number three. The adult spotted salamander, with its yellow on glossy black colors, looks much like the adult tiger salamander you saw in the pond life book. Spotted salamanders are one of the earliest amphibians to lay eggs in the spring. Some of them arrive at ponds before all the ice is gone from the surface of the ponds. Although spotted salamanders sometimes gather in large numbers during their early spring mating season, they are seldom seen. They stay in hiding during the daytime, and like other salamanders, they aren't able to sing as frogs and toads sing. Hence, their presence at ponds and slow moving streams isn't "advertised" by singing, and few people know that they are about.

If you catch one of these spotted salamanders -- or any salamander, frog, or toad -- you don't have to be afraid of being bitten. Salamanders, frogs, and toads can't bite you or otherwise harm you, but you can easily harm them! You can harm them simply by holding on to them too long. If you hold an amphibian too long, the heat from your hands can be enough to overheat them and to dry their normally moist skin.

Reptiles, such as snakes, lizards, and land turtles, have dry skins. But amphibians have moist skins. Amphibians rely on their moist skins to help them get enough oxygen to stay healthy. Oxygen can enter their bodies directly through their moist skins. When amphibians' skins become too dry, they are in danger of suffocating. So handle salamanders, frogs, and toads with care so that you don't overheat them. Even the thicker, tougher skin of toads can become too dry by over handling. Return slide six and put slide seven in the viewer.

Have you ever seen this tiny reddish colored fellow? This is an immature stage of the spotted newt. It is called a RED EFT. I photographed this red eft in a margarine dish and then returned it to the woods where it was found. Find the book titled, "Reptiles and Amphibians," and turn to page 142. On page 142 is a closer view of a red eft. There you can see pictures of both the immature red eft, and on the next page, the grown-up newts. The written text on pages 142 and 143 tell some interesting things about the life on the common eastern newts. Turn off the tape recorder and read it if you like. (pause)

Did you notice that both the reddish or orangish colored red eft, and the more greenish adult newts, have rows of scarlet dots ringed with black, on their backs? Return this slide and put slide eight in the viewer.

Slide eight shows a closer view of the kind of turtle that the girl is shown holding in the photograph on the bulletin board. This is the eastern painted turtle. There are many varieties of painted turtles. If you are interested in painted turtles, look over the pictures of some of the varieties of painted turtles on pages 32 and 33 of the book about reptiles and amphibians. (pause)

Because painted turtles are not agressive like the rather ornery-acting snapping turtles and soft-shelled turtles, painted turtles make fairly nice pets. I prefer to see them sunning themselves on logs at the edges of a pond, however. After the young lady in the bulletin board photograph had finished inspecting the painted turtle she found while on a bike hike one spring day, she returned it to the stream near the edge of the road she was traveling on.

Turn for a moment to page 38 in the reptiles and amphibians book. Shown on pages 38 and 39 are turtles that I would rather you did NOT take home for pets. Box turtles are to me some of the most interesting of the turtles, and as the book will tell you, they make excellent pets. But because so many people have taken them as pets, and probably for other reasons as well, box turtles are becoming quite RARE. They are now so rare in some states that they are protected by state laws, and may be taken from their natural habitats in woods and swamps, only by people with special permits. Box turtles can be found in this area, but they are becoming rare and should be left in their natural homes.

By the way, spring is a time of new growth -- or birth -- for many turtles, just as it is for other animals. Like the other animals in this lesson, adult turtles don't take care of their offspring once the eggs are laid. And like most amphibians, turtles and most other reptiles, usually produce many eggs, most of which end up as food for other growing animals in the spring and summer.

Animals that carefully watch over their young ones and aid in their growth and development, don't need to produce many offspring in order to insure a new generation. But few species of amphibians and reptiles care for their offspring. Most amphibians and reptiles produce many, many eggs, and only a few of them grow to maturity and produce eggs themselves.

Before we return to the rest of the colored slides, take a look at the bulletin board picture of the girl holding a garter snake. Snakes are another kind of reptile. This species of snake doesn't lay eggs. Garter snakes give birth to young that are born alive -- that is, the young are fully developed and look like minature adults when they are born. Some varieties of garter snakes will give birth to 20 or more young snakes at a time. Even though this is not a large number, most of these become food for hawks and other predaceous animals. Some become food for other kinds of snakes, and some survive to adulthood and produce more garter snakes. Return slide eight now if you haven't already, and look at a common frog, the meadow frog, in slide nine.

This meadow frog is sometimes called a "leopard" frog. Can you guess why? Listen for a moment to the voice of the male meadow frog, with a chorus of spring peepers singing in the background. (twenty seconds of meadow frog singing). Return slide nine and put slide ten in the viewer.

Slide ten shows another fairly large frog that is common to our ponds and marshy areas. This is the green frog. Listen to his voice for a moment. There is a chorus of red-winged blackbirds and some song sparrows singing in the background. Some people think the green frogs' voice sounds like the noise produced when you strum a rubber band. (twenty seconds of green frog singing). Do you think the green frog sounds like a rubber band? (pause) Return the slide of the green frog and put slide eleven in the viewer.

Slide eleven shows an adult bullfrog. Green frogs and meadow frogs grow quite large as frogs go, but bullfrogs are the "giants" of our North American frogs. Turn to page 133 in the book about reptiles and amphibians, and you'll see a picture in which a green frog is compared with a bullfrog. (pause) I'll play some male bullfrog music while you are looking at page 133. The voice of the male bullfrog sounds, to me, like the lowing of a bull in a distant field. It also sounds a little like a poorly played bull fiddle. (twenty seconds of bullfrog singing).

On page 133 of the book about reptiles and amphibians, it is written that bullfrog tadpoles require two summers growth, before they develop into adults in our northern states. If you find some rather large tadpoles in ponds in the spring, you probably have some of last year's crop of bullfrog larvae. Return slide eleven and put the last slide in the viewer.

This well camoflaged little amphibian is a tree frog. Like the spring peeper, and like other climbing frogs and toads, tree frogs have sticky pads on the tips of their toes. Because tree frogs are quite small in size, and because the colors of tree frogs are changeable, they are seldom seen in our woodlands and swampy areas. But tree frogs are often heard! Their loud, ringing calls seem to echo through many a woodlot in early and mid-May. Listen to the call of the common tree frog. (forty-five seconds of first a single tree frog and then a chorus of tree frogs).

Tree frogs continue to sing on summer evenings, and are often heard on summer afternoons before a summer thunder storm. I enjoy falling asleep to a chorus of tree frogs while camping during the late spring and early summer. Return slide twelve and check to see that the slides are in the correct order for the next person.

The next, and final environmental education lesson is about some of the pond animals that you can find on a spring field trip to a pond. When you and your classmates have finished the final lesson, your teachers will try to make arrangements for your class to visit a pond for a spring field trip.

If you decide to take a spring field trip to a stream or a pond with some friends, please be very careful around the water. Some ponds and streams are surprisingly deep, and quite often the sides of them are surprisingly slippery! Even if you are a good swimmer, you should use caution when observing or collecting living things at the edges of ponds and streams.

Remember to write today's date under the lesson two column and across from your name on your lesson use chart. Goodby until our next lesson.

LESSON SCRIPTS

AUDIO-TAPED SCRIPT, SPRING LESSON NUMBER THREE

Hello. I hope you are feeling fine today. This is the third and final spring environmental education lesson. This lesson is about some of the things you can collect and study while on a spring field trip to a pond or a marshy area.

I hope you've already taken some spring hikes and field trips with your friends. Trips to woodlands, fields, marshes -- to any place where one can find natural and unpolluted living conditions -- can be fun and interesting. Knowing something ABOUT the living things you find outdoors, and knowing things about how all the living things INTERACT with each other and with their non-living environment, makes field trips even more fun and interesting.

This lesson is about some kinds of pond life -- its about things that live most of their lives around and under the surface of ponds. Ponds have many fascinating things living in them. Some of the organisms are found in no other habitats, and all of them are well designed for living in and around ponds.

On the [illegible]-hand side of the bulletin board you can find a sign that shows the names of a few of the animals that you can find in and around ponds. The top name, "MICROORGANISMS", includes a huge number of animals, all of which are quite tiny. You must use a microscope or magnifying glass to get a good look at microorganisms. If your school has a microscope, maybe you'll be able to take a close look at some pond microorganisms you can find in the pond water you bring back from the class field trip.

You would find that some of the tiny things in pond water are GREEN in color, and that they aren't animals, but are microscopic plants. Most of the very tiny pond plants you can find in pond water are kinds of plants we call ALGAE. The "Pond Life" book from the Golden Nature Guide book series in your science classroom, can help you identify some of the microscopic plants and animals you can find in pond water.

The bulletin board sign has "worms" as the second kind of animal on the list. The worms you can find in ponds are not the same kind of worms that you find living in the soil. Take the "Pond Life" book in the booth, and turn to pages 82 and 83, for a moment. (pause)

Pictured on pages 82 and 83 are some of the interesting kinds of worms you can find in some ponds. You may have already run into some of these while swimming in ponds and lakes. Leeches, one type of pond and lake worm, can be a real nuisance when you're swimming, but I've never been bothered by them while collecting pond life on a field trip.

While you are in the "worm section" of the book, look for a moment at the interesting flatworms on page 84. (pause) The flatworms shown there fascinate me. Maybe its their light-sensitive eyespots, that actually look like eyes, that make these tiny animals so interesting. These flatworms are tiny. The book says that some species can grow to about one inch in length, but all I've ever found have been smaller.

I'm sure you're familiar with many of the other pond animals listed, and you've probably seen a variety of different species of some of them. There are many more kinds of pond animals than those listed. The other bulletin board list is also about different kinds of living things you can find in ponds. This list GROUPS the living things, NOT by names, but rather it groups them by HOW THEY LIVE.

On land, a variety of WAYS OF LIVING are found among land plants and animals. Many different ways of living are also found in the organisms that live in ponds. A healthy, well balanced land habitat has many kinds of organisms that have many different ways of living. So does a healthy pond.

In both land and water habitats, plants are the FOOD MAKERS for the other living things. Plants also provide another life requirement material. Do you remember what it is? (pause) On both the land and in the water, plants release oxygen. And oxygen is an element that is needed by almost ALL forms of life.

On land, predators like prairie falcons and foxes are necessary to help keep rodent populations from becoming too large. Predators are needed in ponds too. In ponds they help control populations of other pond animals. Have you ever had a sunfish or a bass grab your minnow while you were fishing? Sunfish and bass are two of the many different kinds of predators that you can find in ponds. If you catch and eat a pond fish, you too are a predator. Fishing can be an effective way of managing some fish populations.

The photographs on this lesson's bulletin board show some other pond predators. The adult dragonfly in the top photograph is an efficient predator. It eats many other insects that are found around ponds and low lands. The large eyes of dragonflies frighten some children I think, but you need not be afraid of the "mosquito-catcher". Dragonflies can't hurt YOU, but they do do some damage to mosquito populations. You may have noticed them far from ponds. They often fly far from the watery home they grow up in.

The large-eyed insect with the shorter, wide body, in the lower right-hand bulletin board photograph, is a "teenage" dragonfly. It wasn't an adult when I took its photograph. By the way, all the bulletin board photographs have been enlarged so you could get a closer view of these insects.

The immature dragonfly is called a dragonfly NYMPH by scientists. Like its parents, it too is a predator. Dragonfly nymphs can't range far from the pond to hunt. They must stay in the water. The nymphs have gills, and they have very tiny, non-working wings. They must stay under the surface of the pond until their final molt. But like their parents, they also help control the mosquito population, for young mosquitos, like young dragonflies, spend their "growing up" time in shallow water. Young mosquitos make up part of the diet of young dragonflies. I'm certain we will catch some dragonfly nymphs on a pond field trip, and I think you'll enjoy seeing the unusual prey-catching lower lip each dragonfly nymph has.

The lower left-hand bulletin board photograph is a picture of another underwater predator. This one is called a WATER SCORPION. It really isn't a scorpion. It is an insect, and it is one of the insects that can correctly be called a BUG. This long, stick-like bug is to me one of the most fascinating of the pond insects. Water scorpions lurk in among the twigs, leaves, and other material commonly found in the water at the edges of ponds. They catch quite a variety of underwater pond creatures, and suck out each prey's body juices by means of a short, sharp, needle-like mouth. Can you see the needle-like mouth on the water scorpion in this picture? (pause)

Water scorpions don't have to stay under water. They have wings, which are usually held down tightly over their abdomens. Water scorpions can breath while out of water too. They don't have gills as dragonfly nymphs do. While water scorpions are under water, they use a breathing device similar to one you may have used if you've ever been "snorkeling." Water scorpions have a "built-in" snorkel -- an air tube -- that extends from the back end of their abdomen. I'm afraid I missed most of this water scorpion's snorkel when I took this picture. You can see just the beginnings of it in the upper right-hand corner of the picture. We may find some water scorpions on a pond field trip, and if we do, you can take a close look at this bug's snorkel tube.

The next "way of living" group on the list, is the group of animals called PARASITES. I think you know what "parasite-living" is like. Fleas and ticks, often found on dogs, are examples of some common land parasites. Parasites, unlike predators, usually don't kill the animals they come in contact with. Parasites sort of "nibble-away" at their host animals. Too many parasites on or inside a host animal can so weaken the host animal that it might die from other causes. For example, moose that are heavily infested with inside and outside papasites, often are the first to fall victim to wolves -- in the few places where we have allowed wolves and moose to live on the earth. The water scorpion in the bulletin board picture was a rather rare specimen by the way. It didn't have any parasites living on it when I caught it. Almost all the many water scorpions I've seen have had one or more tiny, red parasitic water mites attached to their legs or to their abdomens.

Let's go to today's slides now. I'll talk more about some of the other ways of living on the list while you are looking at some of the slides. Put the first slide in the viewer and take a look at some of the pond life collecting equipment I use when I visit ponds and lakes in the spring and summer.

Can you recognize some of the tools shown here? (pause) None of them are very expensive. But they are useful. The medicine dropper -- sometimes called an eye dropper -- is very useful in picking tiny pond organisms from the water. The trowel is used for collecting samples of pond bottom materials near the edges of ponds. The yellow strainer can be used for lifting larger pond insects and tadpoles from the water. The same thing can be done with the soup strainer, the tool with the white handle. I usually keep one soup strainer around that has a long handle attached to it. The long-handled soup strainer is handy for collecting pond life when the water near the shore is deep, or when I want to reach farther out from the shore to collect. Return slide one and put slide two in the viewer now.

Slide two shows a girl collecting pond life with a soup strainer. The soup strainer is by far the best pond life collecting tool I've found. The wire mesh is small enough to collect some very tiny pond organisms, and still the six inch width of the strainer is enough that large tadpoles and large pond insects, like water scorpions, will fit in the strainer. Return slide two and put slide three in the viewer.

Slide three shows the container I use to examine the pond life I collect with each scoop of the strainer. I also use milk carton bottoms as aquaria at home. I keep a small number of different kinds of pond animals in a number of milk carton aquaria, and include a few pond plants in each to provide food for the plant eaters and oxygen for all the pond life. One-half gallon cartons are a good size to use, but gallon milk cartons provide even more room. Return slide three and put slide four in the viewer.

The pond animal shown in slide four is correctly called a water bug. Like the water scorpion, and like all true bugs, the water bug has a needle-like mouth which is used to suck the juices from materials it eats. Some kinds of bugs suck juices from plants, but the water bug, like the water scorpion, is a predator. It sucks juices from animals. Just before I took this picture, the water bug had extended its tail, rather, the end of its abdomen, above the water in order to get some air. The water bug can live above the water, and it must come to the surface to get air. This water bug was about the size of a nickle. A close relative of this water bug is one called the "Giant Water Bug." Giant water bugs grow to a length longer than the length of your thumb. You may have seen some of these large bugs around street lights in the late spring and early summer. They are a common sight in towns and cities that are close to rivers or ponds. Return slide four and put slide five in the slide viewer.

Slide five shows another true bug. This pond bug is a backswimmer. It usually swims on its back -- that is, up-side-down -- under the surface of ponds, lakes, and streams. Backswimmers must come to the surface to get bubbles of air. They take bubbles of air down under the surface of the water, and use the bubbles like a gill. Oxygen from the water enters the captured bubbles much like oxygen enters real gills found in many other pond animals.

The backswimmer is one pond insect that you should handle carefully. Very few pond animals will jab you, but the colorful backswimmer can, and will. I don't keep backswimmers in my aquaria because they have a tendency to jab, and also because they have a tendency to fly away. Return slide five and put slide six in the viewer now.

Slide six is a picture of an adult damselfly. Damselflies are close relatives of dragonflies. They look and act much like dragonflies. Like adult dragonflies, adult damselflies have rather large eyes, long transparent wings, and a rather long body. And like adult dragonflies, adult damselflies are predators "on the wing." You can tell the two apart most easily when you see them resting on a plant or on the end of your fishing pole. Dragonflies hold their wings apart and out to their sides -- sort of like the wings of an airplane. The center bulletin board photograph shows a resting dragonfly holding its wings in an "airplane" position. Adult damselflies usually hold their wings quite close together and above their abdomens when they come to rest. Return slide six and put slide seven in the viewer.

Shown here is an immature damselfly. The young damselflies, like young dragonflies, grow up under water in ponds and lakes. Can you see the small, developing wings on the damselfly nymph in this picture? (pause) Damselfly nymphs, like dragonfly nymphs have gills. But the gills of damselfly nymphs are not hidden inside their abdomens as they are in dragonfly nymphs. The three "leafy-looking" structures at the end of this damselfly's abdomen are its gills.

Damselfly nymphs catch and eat a variety of different small pond animals. And they in turn, are caught and eaten by other pond predators. Return slide seven and put slide eight in the viewer to see another insect nymph that spends its "growing-up time" under the surface of ponds.

Slide eight shows two insects, and a penny for size comparison. The larger insect is another damselfly nymph, similar to the one you saw in the last slide. Can you see its three "tail" gills? (pause) The other insect is a young mayfly. Like damselflies, mayfly nymphs have gills with which they get their needed oxygen from the pond water.

Mayfly nymphs have two rows of gills along the top of their abdomens. It may be a little difficult to see the rows of gills on the mayfly nymph shown here. Find the book titled, "Insects" in the booth, and turn to page 52. (pause) On page 52 you will see both the adults and the nymphs of one species of mayfly, and one species of another pond insect, the stonefly. The mayfly nymph shown in the bottom picture on page 52, has rather "feathery" gills. Stonefly nymphs also have outside gills. But stonefly nymph gills are not as easily seen. They aren't shown in the illustration on page 52. Stonefly nymphs' gills are small tufts of threadlike things that are found on their undersides. It takes close inspection to see them. You can find both these nymphs in many ponds, and you can tell them apart by counting the number of tail filaments or tail structures. Most stonefly nymphs have two tail filaments from the ends of their abdomens. Most mayfly nymphs have three such tail filaments.

There is an adult mayfly in the upper illustration on page 52. Adult mayflies live only a few days after they leave the water. They usually emerge from the water in great swarms. Then they mate and the females lay their eggs in ponds, marshes, lakes, and streams. Shortly afterward they die. You may have seen large numbers of them around street lights or around store front lights on late spring and early summer evenings.

You can pick them up without fear of being bitten. They can't bite you. They can't bite anything for that matter. Adult mayflies don't have mouth parts that are functional, and they don't eat! Mayfly nymphs do eat of course, for they live for many many months before they become adults.

Young mayflies eat both tiny pond plants and tiny pond animals. They are OMNIVOROUS, like you and I. Both plant and animal foods are found in their diets. The stonefly nymphs are not omnivorus. Their eating habits put them into a group of animals we call HERBIVORES. They are HERBIVOROUS. They are plant eaters. Most stoneflies eat various kinds of pond algae -- the smallest and most common kind of pond plants. Stonefly nymphs and other plant eating pond animals form a sort of a FOOD LINK between the food making pond plants and the predators, the animals that eat the plant eaters and other animals. Return slide eight and put slide nine in the viewer.

Slide nine shows more omnivorous immature pond insects. They look, on first inspection, like bundles of tiny sticks, or like strange looking caterpillers. What you are seeing are the "log cabin-like" protective houses of some CADDISFLY larvae. These wormy-looking immature insects build protective homes about their rather soft bodies.

Pick up the insect book again, and turn to page 57. On page 57 you will see pictures of the larvae of three different species of caddisflies. There is also a picture of the adult of one species of caddisfly. Caddisfly species that live in ponds and lakes, build their homes of bits of leaves and other plant materials. Those species that live in streams and rivers, build their homes from sand grains and tiny pebbles combined with sand grains. Sand and pebble houses aren't as easily swept away by stream currents, as are plant material houses. Can you see the tiny snail shells that were cemented in with other materials in the house of one of the caddisfly larvae in the lower picture on page 57? (pause)

Caddisfly house building is fun to watch. If you collect some of the log cabin builders, like those shown in the color slide, you can have them build a house OF THE COLOR you choose. I've added tiny shavings from colored toothpicks to a milk carton aquarium with this kind of caddisfly, and watched them construct multi-colored houses in less than a week. Return slide nine and put the last slide in the viewer.

Slide ten shows an adult beetle that can be found in most healthy ponds.

This streamlined insect is known as the DIVING BEETLE. It uses its long, oar-like hind legs to drive it forward in the water, much like a person in a rowboat uses the oars to move the boat across the water. You may have noticed the long oar or paddle-like legs on the backswimmer in slide five. There are other aquatic insects that also have paddle-like or oar-like legs and streamlined bodies that enable them to travel rapidly through the water.

The diving beetle shown here was in the process of beginning a dive, after having gotten a bubble of air from the surface of the aquarium water. Diving beetles carry air bubbles under the surface of their wings and on the tips of their abdomens. You can often see the shiny air bubble at the ends of diving beetles as they zip through the water while chasing other insects, small tadpoles, and even small fish, for food. Return slide ten and look on page 127 of the insect book.

Shown on page 127 are both the adult and the immature, or LARVAL diving beetle. You can get a good look at the hairy oar-like hind legs of the adult diving beetle in this picture. (pause)

Even the diving beetle larva is a predator. It is shown eating a mayfly nymph in this picture. Now look at the even larger pond beetle, the water scavenger beetle, shown on the preceding page -- on page 126.(pause)

Scavengers are animals that begin the very important job of recycling the materials in the dead remains of plant and animal bodies. Much of the material that living things are made of was EARLIER found as parts of other living things. Scavengers break down dead organisms and use some of the materials to build their own bodies.

Ponds have many scavengers, both large and small. The water scavenger beetle is rather poorly named by the way, because their larvae are predators, and the main food of the adults is algae. Turtles, crayfish, catfish, carp, and small crustaceans called SCUDS are pond scavengers, too. These animals will eat some live organisms too, however.

The small flatworms with the interesting eyespots you looked at earlier in the pond life book, are an example of the small-sized scavengers found in ponds. The work of scavengers is continued in ponds, by even smaller organisms, the BACTERIA and some kinds of FUNGI.

These microoganisms are usually referred to as DECOMPOSERS or as DECAY organisms. Most people think of bacteria and fungi as something "bad." But, nothing could live on earth without the important work of decomposers. Bacteria and fungi that break down -- that is decompose or decay -- the dead remains of former living plants and animals, and the waste products of animals, are absolutely necessary to the health of all habitats -- both on land and in the water.

The decomposers change dead materials and waste products of living things into new forms that can be REUSED by living things. They change such such materials into forms that can be RECYCLED through living plants and animals again. Some people think that the earth's decomposer bacteria are the most important forms of life on earth. When it comes to making materials available for new life and the new growth of living things, these people are right. Most of the bacteria in the world are good for life -- they are necessary for life. But bacteria have gotten a bad name because some kinds of bacteria cause diseases, and these kinds of bacteria are the ones we hear about most often.

Food-making plants, predators, parasites, plant eaters, scavengers, and decomposers, are all necessary to make a healthy habitat. They are all needed to make a healthy pond habitat. You can tell healthy pond, river, marsh, and lake water, by the abundance of LOTS OF DIFFERENT KINDS of living things, and lots of different kinds of ways of living. Ponds that have the right balance of plants, predators, parasites, plant eaters, scavengers, and decomposers, are healthy ponds.

When we pollute ponds, streams, and lakes, we usually do it by adding substances to the water that UNBALANCE the numbers of organisms, and the varieties of ways of living. We end up with fouled water -- with polluted water that will take much work to bring its life forms back into balance.

This is the end of today's lesson. Please be certain that the slides are in the correct order for the next person. By the way, your science teacher has copies of both the "Pond Life" book and the "Insects" book if you want to look through them further.

If you are planning a pond field trip with some friends before your class trip, please be very careful near the water. Rewind the tape and write today's date by your name on the lesson use chart. Goodby.

STUDENT LESSON USE CHART

ENVIRONMENTAL EDUCATION LESSONS

1. AFTER YOU FINISH EACH LESSON, FIND YOUR NAME ON YOUR CLASS LIST.
2. PLEASE WRITE IN THE DATE YOU TAKE THE LESSON, AFTER EACH LESSON.
3. WRITE THE DATE IN THE BOXES THAT FOLLOW YOUR NAME. THERE IS A BOX FOR EACH LESSON.
4. IF YOU GO THROUGH A LESSON MORE THAN ONCE, PLEASE WRITE AN "X" UNDER THE DATE YOU WROTE IN THE FIRST TIME YOU WERE AT THE LESSON.

CLASS ____________________

NAMES	LESSON 1	LESSON 2	LESSON 3	LESSON 4

WINTER WILDLIFE ECOLOGY GAME

GAME OBJECTIVES AND RULES OF PLAY

HOW WAS YOUR WINTER?

A WILDLIFE ECOLOGY GAME

OBJECT OF THE GAME

The object of this game is TO SURVIVE THE WINTER. To do this a player must avoid such hazards as starvation, disease, insufficient cover during blizzards, automobile traffic, sudden flooding, becoming weakened by parasites, and in the case of prey species, being caught and eaten by predators.

Each of the players assumes the role of one of six kinds of wildlife, common to much of North America. The WINNER of the game may be the player, or players, who lose no members of their species during the game.

Because the game resembles real life situations encountered by the six wildlife species, the game will usually run for several hours before all but one species has been eliminated from the game. Therefore it is a good practice to set a game time limit before beginning.

All wildlife species that have lost none of their members at the end of the time limit, are declared winners. Those species that have lost only a portion of their members -- the most common and most natural situation -- may also be considered to be winners.

Species that have lost all of their members are declared losers. Very rarely in nature are all members of a wildlife species eliminated from an area, except when man carelessly causes the extinction of a species.

PREPARING TO PLAY - RULES FOR SIX PLAYERS

Shuffle the 6 four by six inch wildlife species IDENTIFICATION CARDS and place them face down on the gameboard. Each of the players should take an identification card. The card tells each player the name of the species he will represent during the game. The identification cards can now be set aside.

Now the 6 larger RULES OF PLAY CARDS should be distributed. The great horned owl rules of play card is used by the great horned owl player, etc.

Shuffle the 24 special EVENT CARDS and place them face down in a pile.

SETTING UP THE GAMEBOARD

Colored checkers represent individual animals. Before play begins, all checkers should be placed on the gameboard within the 36 spaces. Checkers of the same or of different colors may be placed on the same space to begin the game. THERE ARE HOWEVER, GOOD PLACES AND POOR PLACES to place checkers. A space that is a good place -- that is, it represents a good habitat -- for one species, is not necessarily a good place for other species.

Following is a list of wildlife species, number of members in each population, and the color of the checkers that represent individual members of each population:

WILDLIFE SPECIES	COLOR OF CHECKERS	POPULATION SIZE
Woodland Deermouse	black	8
Meadow Vole	red	8
Cottontail Rabbit	blue	4
Ring-necked Pheasant	yellow	4
Great Horned Owl	green	2
Red-tailed Hawk	red and black	2

To find out WHERE to put his checkers to begin the game, each player should read the RULES OF PLAY card for his wildlife species. Before placing his checkers on the gameboard, each player should know which spaces (habitats) provide food, food and cover, cover only, a possible hazard, and in the case of the predator species, which areas are the best hunting areas.

Each player should also read his rules of play card to discover what circumstances will result in the LOSS OF MEMBERS of his species. Hazards resulting in the removal of members of each species, vary somewhat among the different species.

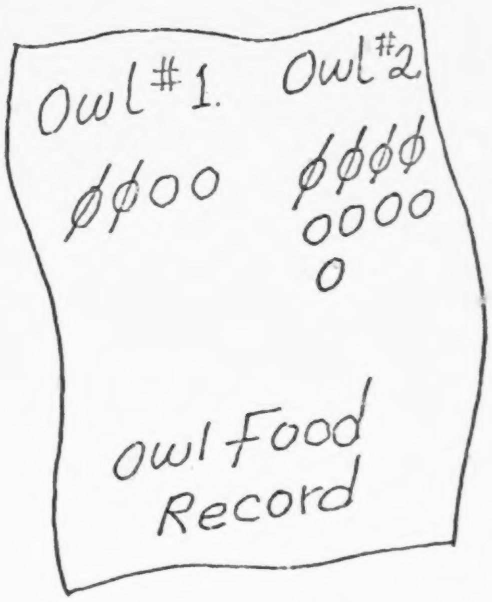
Predator species players (owl and hawk) will find it to their advantage to place their checkers on spaces representing habitats in which their prey can find no protective cover, if the prey species are forced by a toss of the dice, to enter the space.

Prey species players will find that the best places to begin play are the spaces (habitats) that provide BOTH FOOD AND COVER to their species. By reading side two of their rules of play cards, prey species players can find the types of areas that provide both food and cover to their animals.

Predator species players will find that starvation is their principal hazard. The owl player and the hawk player ARE REQUIRED TO KEEP A FOOD RECORD of their eating frequency. Diagram 1. on the next page shows one method of keeping a record on a piece of scrap paper.

Prey species members can also starve, but prey species players will find that the two predator species pose a greater threat to their members. Also hazardous to members of both prey and predator species, are most of the events on the special events cards.

Diagram 1. AN OWL FOOD RECORD.



Circles have been used in this food record to indicate both the original four "no eating required" or "food free" turns, and to indicate later "earned" food free turns.

A circle is crossed out as the owl player completes a turn. New circles are added each time the owl catches a prey animal. The number of circles that are added, depends on the "food value" of the prey species that was caught.

In the example shown here, owl number one has taken two of its original four food free turns. The record shows that owl number one has caught no prey. Owl number two has taken four turns. On one of the turns, owl number two caught either a rabbit or a pheasant, and earned five additional food free turns.

Only the great horned owl player and the red-tailed hawk player need keep a written record of their eating frequency. The prey species will be able to keep track of their eating by attempting to keep their members in food areas which also provide protective cover from predation. Starvation does constitute a hazard to all prey species, but other hazards normally deplete the prey species populations faster in this game.

TO BEGIN PLAY

One of the six players is chosen to take the first turn. To take a turn, a player first SPINS THE SPINNER. A player draws a SPECIAL EVENTS card only if so instructed by the spinner.

To complete a turn, a player must toss the dice to determine the coordinates of the square to which he will move one of his checkers. A PLAYER MAY COMPLETE A TURN BY TOSSING THE DICE AND MOVING A MEMBER, only if the spinner comes to rest on a TIME OF DAY when his species is active.

The RULES OF PLAY card for each species tell each player WHEN -- that is, what time of day -- members of his species are active. Refer to the examples in Diagram 2. on the following page, to find how a player knows what time of day he has spun.

Note that a player takes a SPECIAL EVENTS CARD even though he spins a time of day when his species is not active and therefore can not complete that turn. A player takes a special events card only when the spinner comes to rest on one of the two edges which bear the word "card".

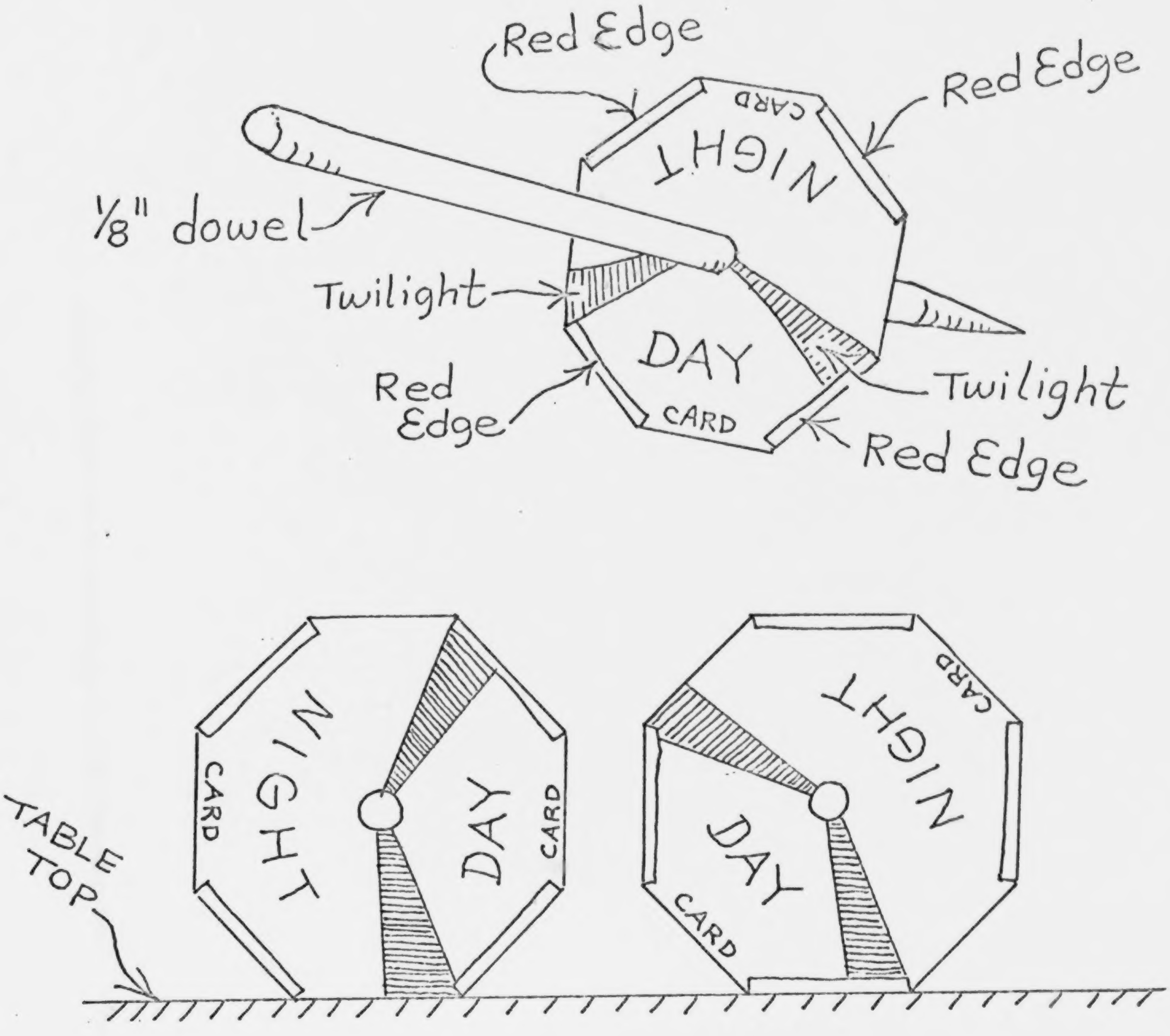

Red Edge
Red Edge
1/8" dowel
Twilight
NIGHT
CARD
DAY
CARD
Twilight
Red Edge
Red Edge
TABLE TOP
NIGHT
CARD
DAY
CARD
NIGHT
CARD
DAY
CARD

Diagram 2. The game spinner, shown in three positions.

The top illustration, showing the entire spinner, shows the spinner resting on a combination DAY and CARD edge. The player whose spinner stops in this position, must take a special events card and follow its direction, if it applies to the species he represents.

If the player also represents a "day-active" (diurnal) species, he must toss the dice to determine the coordinates of the space to which he will move a member of his species. Players who represent "night-active" only (nocturnal) species, may not complete their turn when the spinner rests on a DAY edge. Some players will have a choice of tossing the dice and completing their turn, or of passing the dice to the next player and not completing the turn.

The lower, left-hand spinner in Diagram 2 shows the spinner at rest on a combination NIGHT and TWILIGHT edge. All players MAY toss the dice and complete their turn when the spinner rests in this position. SOME PLAYERS MUST toss the dice and complete their turn when the spinner rests in this position.

The lower, right-hand spinner in Diagram 2 shows the spinner at rest on a combination DAY, TWILIGHT, and RED EDGE, edge. Again, all players may toss the dice and complete their turn because the spinner rests on one of the two twilight areas. And again, some players MUST toss the dice and complete their turn.

Predator species players have the RED EDGE ADVANTAGE when their spinner rests on one of the four red edges, as it is in the lower, right-hand illustration of diagram 2. In this instance, either predator species player could complete his turn, because the spinner rests on a twilight edge. A spinner thrown by a prey species player and stopping on a red edge, does not give the prey species player any advantage. Neither does it give prey species players a penalty.

HOW TO MOVE

When a player has found the time of day, and knows that he must move, or if he has the option and wants to move, he then throws the dice to determine WHERE he will move ONE checker -- that is, one member of his species.

If a player has the choice of moving or not moving, the decision MUST BE MADE BEFORE HE THROWS THE DICE. If a player has the option, and throws the dice, he must move. If a player has the option and decides not to move, he should pass the spinner and the dice to the next player, as he would at the end of his turn.

A PLAYER HAS TAKEN A TURN ONLY IF HE THROWS THE DICE AND MOVES A CHECKER.

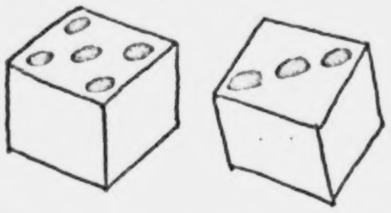
After the dice are thrown, their numbers are read when they come to rest. By using the gameboard coordinates, the player determines WHERE he must place one of the checkers that represent his species. For example, if one die reads 5 and the other reads 3, the player will place a member of his choice on EITHER of the two spaces whose coordinates are 5 and 3.

The player should choose the space (habitat) that is LEAST HAZARDOUS to his species, and if possible, a habitat that offers BOTH food and cover, if the player represents a prey species.

If a player throws DOUBLES he has no choice, and must place one checker of his choice on the space with the coordinates of the double throw.

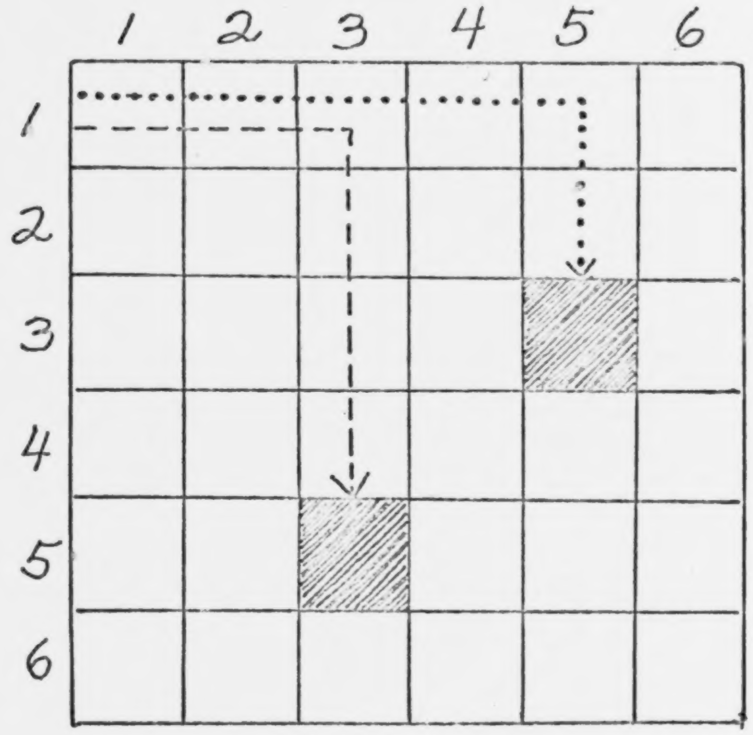
Diagram 3 on the following page will help you understand the coordinate system used in moving checkers.

Diagram 3. The use of the coordinate system.



In the example shown here, the player has thrown 5 and 3. He will move one checker of his choice, to EITHER of the spaces with coordinates, 5 and 3.

To locate the spaces, the player should count across three spaces and down five spaces, as illustrated by the dashed line, and count across five spaces and down three spaces, as illustrated by the dotted line.



YOU ARE READY TO BEGIN PLAY

My advice to the four prey species players is to try to keep your members in habitats that offer both food and cover.

To the two predator species players, I would suggest that you keep your animals in areas that do not provide cover for most or all of the prey species.

Have fun, and may the spring season find you in good health!

RULES OF PLAY FOR THREE PLAYERS

"How Was Your Winter" may be played with three players in a manner similar to the game played by six players. Three players should, however, use only either the predominately diurnal species (hawk, pheasant, and meadow vole) OR use only the predominately nocturnal species (owl, rabbit, deermouse).

When playing with three players, you must continue to use the spinner in order to determine when a special events card is to be used, and to know when the predator has the red edge advantage over the prey species.

WINTER WILDLIFE ECOLOGY GAME

MATERIALS LIST

HOW WAS YOUR WINTER?

A WILDLIFE ECOLOGY GAME

Your school's copy of the winter wildife ecology game, "How Was Your Winter?" should include the following game materials:

1. Gameboard. The gameboard has thirty-six spaces on it. Each space is labeled with a description of the kind of habitat or place it represents. The gameboard is fourteen inches square, and is designed to fold down the middle for easy storage when not in use.

   A copy of the gameboard is shown on the next page. When time does not allow players to finish a game, copies of the gameboard may be made and used to record players' checker positions, and thus assist in setting up the gameboard when play can be resumed at a later date.

2. Species identification cards. There are six, four inch by six inch cards, each with one of the following wildlife species names:

   a. Woodland Deermouse
   b. Meadow Vole
   c. Cottontail Rabbit
   d. Ring-necked Pheasant
   e. Great Horned Owl
   f. Red-tailed Hawk

   The species identification cards are used at the beginning of the game to determine which wildlife species role each of the six players will play.

3. Rules of Play cards. There are six separate rules of play cards, one each for the six wildlife species listed above. These cards are four inches by six inches in size. A copy of the playing rules for each wildlife species follows:

   a. Woodland Deermouse. Rules of Play card, Side One.

      There are 8 Woodland Deermice. Deermice MUST be active (take their turn) during the night. A deermouse may take its turn during either twilight time, or it may refuse to move during times of sunset and dawn twilight. Deermice MAY NOT be active during the day.

      The woodland deermouse player stays in the game as long as at least one deermouse is on the gameboard. Only one deermouse moves each deermouse turn.

      A deermouse IS REMOVED from the game when: 1. a hawk or an owl lands with it when it is on a no cover deermouse space.

WINTER WILDLIFE ECOLOGY GAME, "HOW WAS YOUR WINTER?"

GAMEBOARD COPY

	1	2	3	4	5	6
1	GRASSY MARSH		OLD CONIFER WOODS		BRUSHY AREA WITH WEEDS	
2	OLD HARDWOOD WOODS		RECENTLY		BRUSH PILES IN WEEDY FIELD	
3	YOUNG TREES AND BRUSH		BURNED OUT AREA		WEEDY FIELD	
4	ROAD	ROAD	ROAD	ROAD	ROAD	ROAD
5	HEAVILY GRAZED PASTURE			PARTLY HARVESTED CORNFIELD		ROAD
6	HEAVILY GRAZED PASTURE			PARTLY HARVESTED CORNFIELD		ROAD

2. a deermouse lands on a space with an owl at night. 3. a deermouse lands on a space with a hawk during either twilight time. 4. A hawk or an owl lands on any space with a deermouse when the predator's spinner rests on a Red Edge. 5. a deermouse lands on the road. 6. a deermouse stays in a "no food" area for deermice, for more than one turn.

Woodland Deermouse. Rules of Play card, Side Two.

FOOD AND COVER areas for deermice: 1. Old conifer woods. 2. Old hardwood woods. 3. Young trees and brush. 4. Brushy area with weeds. 5. Brush piles in weedy field. 6. Weedy field. 7. Cornfield.

FOOD ONLY areas for deermice: None

COVER ONLY areas for deermice: 1. Grassy marsh.

HAZARD areas for deermice: 1. Burned out area. 2. Pasture. 3. Road.

b. Meadow Vole. Rules of Play card, Side One.

There are 8 Meadow Voles. Meadow voles MUST be active (take their turn) during both of the twilight times. A vole may take its turn during either the day or the night, or it may refuse to move during times when only "day" or "night" are shown by the spinner. Only one vole moves each vole turn.

The meadow vole player stays in the game as long as at least one vole is on the gameboard.

A meadow vole is REMOVED from the game when: 1. a hawk on an owl lands with it when it is on a no cover vole space. 2. a vole lands on a space with an owl at night or at twilight. 3. a vole lands on a space with a hawk during daytime or twilight. 4. a hawk or an owl lands on any space with a vole when the predator's spinner rests on a Red Edge. 5. A vole lands on the road. 6. a vole stays in a "no food" area for voles, for more than one turn.

Meadow Vole. Rules of Play card, Side Two.

FOOD AND COVER areas for voles: 1. Cornfield. 2. Grassy marsh. 3. Weedy field. 4. Brush piles in weedy field. 5. Young trees and brush. 6. Brushy area with weeds.

FOOD ONLY areas for voles: None

COVER ONLY areas for voles: Old hardwood woods.

HAZARD areas for voles: 1. Burned out area. 2. Pasture. 3. Old conifer woods. 4. Road.

c. Cottontail Rabbit. Rules of Play card, Side One.

There are 4 cottontail rabbits. Rabbits MUST be active (take their turn) during both twilight times. A rabbit may take its turn during either the day or night, or it may refuse to move during these times. Only one rabbit moves each rabbit turn.

The cottontail rabbit player stays in the game as long as at least one rabbit is on the gameboard.

A cottontail rabbit is REMOVED from the game when: 1. a hawk or an owl lands with it when it is on a "no cover" rabbit space. 2. A rabbit lands on a space with an owl during either the night or one of the twilight times. 3. a rabbit lands on a space with a hawk during either the day or one of the twilight times. 4. a hawk or an owl lands on any space with a rabbit when the predator's spinner rests on a Red Edge. 5. a rabbit stays on the road for more than one turn. 6. a rabbit stays in a "no food" area for rabbits for more than two turns.

Cottontail Rabbit. Rules of Play card, Side Two.

FOOD AND COVER areas for cottontail rabbits: 1. Brush piles in weedy field. 2. Brushy area with weeds. 3. Young trees and brush.

FOOD ONLY areas for rabbits: 1. Cornfield.

COVER ONLY areas for rabbits: 1. Grassy marsh. 2. Weedy field. 3. Old hardwood woods.

HAZARD areas for rabbits: 1. Burned out area. 2. Pasture. 3. Old conifer woods. 4. Road.

d. Ring-necked Pheasant. Rules of Play card, Side One.

There are 4 ring-necked pheasants. Pheasants MUST be active (take their turn) during both twilight times. A pheasant may takes its turn during the day, or it may refuse to move during the day. A pheasant MAY NOT move at night. Only one pheasant moves each pheasant turn.

The ring-necked pheasant player stays in the game as long as at least one pheasant is on the gameboard.

A pheasant is REMOVED from the game when: 1. a hawk lands with it, or an owl lands with it, when it is on a "no cover" area for pheasants. 2. A pheasant lands with either a hawk or an owl during either twilight time. 3. A pheasant lands on a space with a hawk during the day. 4. a hawk or an owl lands on any space with a pheasant when the predator's spinner rests on a Red Edge. 5. a pheasant stays on the road for more than one turn. 6. a pheasant stays in a "no food" area for pheasants for more than two turns.

Ring-necked Pheasant. Rules of Play card, Side Two.

FOOD AND COVER areas for ring-necked pheasants: 1. Brush piles in weedy field. 2. Brushy area with weeds. 3. Weedy field.

FOOD ONLY areas for pheasants: 1. Cornfield.

COVER ONLY areas for pheasants: 1. Grassy marsh. 2. Young trees and brush. 3. Old conifer woods.

HAZARD areas for pheasants: 1. Burned out area. 2. Pasture. 3. Old hardwood woods. 4. Road.

e. Great Horned Owl. Rules of Play card, Side One.

There are 2 great horned owls. Great horned owls MUST be active (take their turn) during the night. Owls may take a turn during either of the twilight times, or they may refuse to move during twilight times. Owls may NOT move during the daytime. Only one owl moves each owl turn.

The great horned owl player stays in the game as long as at least one owl remains of the gameboard.

An owl is REMOVED from the game when: 1. It remains on the road too long. (See the road hazard details on side two of this card.) 2. An owl does NOT EAT at least one rabbit or pheasant at least once every six turns -- OR -- it does NOT EAT a deermouse or a vole at least once every three turns.

Eating a rabbit or a pheasant gives an owl five "food free" turns. Eating a deermouse or a vole gives an owl two "food free" turns.

Each owl begins the game with four "food free" (no eating required) turns. The owl player must keep an eating frequency, or "food record" record for EACH of his two owls.

Great Horned Owl. Rules of Play card, Side Two.

FEEDING and FEEDING AREAS for great horned owls: 1. When the spinner rests on a NIGHT Red Edge, or on a TWILIGHT Red Edge, an owl may eat any (one) prey animal in the space on which the owl lands. 2. When the spinner does not land on a Red Edge, but it does land on a time when the owl may be active, an owl may take any (one) prey animal that is NOT PROTECTED in the space upon which the owl lands. 3. Prey animals that land with owls in unprotected (no cover) areas during either the night or twilight times, may be eaten by an owl.

HAZARD areas for great horned owls: An owl that remains on the road for more than one turn is removed from the gameboard.

Note to the great horned owl player: A red-tailed hawk is not a prey of a great horned owl.

f. Red-tailed Hawk. Rules of Play card, Side One.

There are 2 red-tailed hawks. Hawks MUST be active (take their turn) during the day. Hawks may take a turn during either of the twilight times, or they may refuse to move during twilight times. Hawks may NOT move during the night. Only one hawk moves each hawk turn.

The red-tailed hawk player stays in the game as long as at least one hawk remains on the gameboard.

A hawk is REMOVED from the game when: 1. It remains on the road too long. (See the road hazard details on side two of this card.) 2. A hawk does NOT EAT at least one rabbit or pheasant at least once every six turns -- or -- it does NOT EAT a deermouse or a vole at least once every three turns.

Eating a rabbit or a pheasant gives a hawk five "food free" turns. Eating a deermouse or a vole gives a hawk two "food free" turns.

Each hawk begins the game with four "food free" (no eating required) turns. The hawk player must keep an eating frequency, or "food" record, for EACH of his two hawks.

Red-tailed Hawk. Rules of Play card, Side Two.

FEEDING and FEEDING AREAS for red-tailed hawks: 1. When the spinner rests on a DAY Red Edge, or on a TWILIGHT Red Edge, a hawk may eat any (one) prey animal in the space on which the hawk lands. 2. When the spinner does not land on a Red Edge, but it does land on a time when the hawk may be active, a hawk may take any (one) prey animal that is NOT PROTECTED in the space upon which the hawk lands. 3. Prey animals that land with hawks in unprotected (no cover) areas during either the daytime or twilight times, may be eaten by a hawk.

HAZARD AREAS for hawks: A hawk that remains on the road for more than one turn is removed from the gameboard.

Note to the red-tailed hawk player: A great horned owl is not a prey of a red-tailed hawk.

4. Checkers. Twenty-eight colored checkers, five eighth inch in diameter and three eights inch in height, are used to represent the individual members of the six wildlife species populations. Included are 8 red, 8 black, 4 blue, 4 yellow, 2 green, and 2 red and black checkers.

5. Dice. One pair of dice is used with a coordinate system, to determine the specific habitat area to which a player will move a member of his species during his turn.

6. Spinner. A spinner is used to determine the time of day each turn. Included as part of the spinner, is a one eighth inch dowel, four inches in length. A diagram of the spinner may be found in the GAME OBJECTIVES AND RULES OF PLAY section.

7. Special Events Cards. There are twenty-four special events cards, each 2½" x 3" in size. Eleven different events, all of which influence the population size of one or more species, are described on the cards. A copy of the event message and instructions of the eleven special events follows. The actual number of cards for each special event is shown in parentheses following the message and instructions.

a. In search of food, a member of your species from a nearby area has immigrated into this area. IF you have had any of your animals removed from the game for any reason, RETURN one to the gameboard now. (four cards)

b. Some members of your species have become infested with parasites, such as lice, mites, fleas, or ticks. One member has become so weak that it can not travel far enough to get food. Remove one of your animals from the gameboard. (two cards)

c. A bacterial disease has infected all members of your species. One member died. Remove one of your animals from the gameboard. (two cards)

d. There was a blizzard. One of your animals was not able to find protective cover, and it died from exposure. Remove one of your animals from the gameboard. (two cards)

e. PREY SPECIES ONLY. A cat from a nearby farm caught one of your animals. Remove one of your animals from the gameboard. (two cards)

f. PREY SPECIES ONLY. A fox left its normal hunting territory in another area, and entered this area for a short time. It caught one member of your species. Remove one of your animals from the game. (two cards)

g. COTTONTAIL RABBIT AND RING-NECKED PHEASANT PLAYERS ONLY. If you are either the rabbit or the pheasant, a hunter has bagged one member of your species. Remove one of your animals from the gameboard. (two cards)

h. MEADOW VOLE AND WOODLAND DEERMOUSE PLAYERS ONLY. Warm weather caused a sudden thaw. This resulted in some flooding. One of your animals was trapped in the flood. Remove one of your animals from the gameboard. (two cards)

i. WOODLAND DEERMOUSE OR MEADOW VOLE PLAYERS ONLY. A Snowy Owl, an emigrant from the far north, has moved into this area for a short time. It just caught one member of your species. Remove one of your animals from the gameboard. (two cards)

j. MEADOW VOLE PLAYER ONLY. Six inches of fresh snow has recently fallen. All voles are active UNDER THE SNOW, and are protected from all predators for two rounds of turns in all spaces EXCEPT THE ROAD. They may be hit by autos. (two cards)

k. GREAT HORNED OWL AND RED-TAILED HAWK PLAYERS ONLY. An unthinking hunter shot one of your species. Remove one from the gameboard. (two cards)

WINTER FIELD TRIP MATERIALS

JUST SUPPOSE - - - A Winter Field Trip Game

JUST SUPPOSE that most of the land around your school was owned by an elderly couple who are planning to retire and move away from this area.

ALSO SUPPOSE that the couple intend to sell all their property because they are not in good health and they don't feel that they want to be bothered with the worries of paying taxes and insurance on the property and making repairs to the fences on the property.

FURTHER SUPPOSE that a housing and shopping center development company want to purchase all the property near your school in order to develop the land into a housing area and shopping center. The elderly couple would rather not sell the land to them, but the couple do want to sell it soon because they would like to move to their retirement home soon.

Suppose that there is a person who is hopeful of keeping the area around your school in an undeveloped condition so that school children for many years to come may use the land for learning abaut natural environments while on field trips within easy walking distance of their school.

The elderly couple decide that if their property offers living space and good living conditions to wildlife, they will not sell the land to the house and shopping center development company, but will instead sell it to the Nature Conservancy -- an organization that will allow the land to remain in as natural a condition as possible and support wildlife in the future.

BUT the elderly couple have not been able to comfortably walk about on the land near the school, and they don't know that the land does indeed provide living space and living conditions for wildlife. They want to see some evidence that the land is a good place for wildlife, or they will sell the land to the developer rather than to the Nature Conservancy.

FINALLY SUPPOSE that you are asked to help gather or supply evidence that the land is indeed being used by wildlife. You don't have many weeks to gather and supply the evidence of wildlife, because the couple would like to sell the property as soon as possible so that they can leave for their retirement home in a much warmer climate.

WHAT KIND OF EVIDENCE WOULD YOU GATHER, AND HOW WOULD YOU GO ABOUT GATHERING AND SUPPLYING THE EVIDENCE OF THE USE OF THE LAND BY WILDLIFE?

WINTER FIELD TRIP: Wildlife Survey

TYPE OF AREA (Circle one or more numbers)

1. Woods -- Almost all hardwood trees. (Oak, Maple, Birch, Beech, Ash,etc.)
2. Woods -- Almost all conifer trees. (Pine, Spruce, Hemlock, Fir, etc.)
3. Woods -- A mixture of hardwood and conifer trees.
4. Marginal area -- edge area. Edge of woods and brushy area.
5. Marginal area -- edge area. Edge of brushy area and fields.
6. Marginal area -- edge area. (write in ________________________.)
7. Brushy area.
8. Weedy fields.
9. Cropland. (Write in the name of last years crop________________.)
10. Other kind of area. (Write in a brief description _______________ ____.)

WILDLIFE EVIDENCE FROM THE AREA CIRCLED. Write in the name of each wildlife species whose evidence you find, and write in or make a check mark under the kind of evidence you have found for each species you name.

	Name of Wildlife	Saw or Heard it	Sign of Eating	Its home or resting place	Tracks or Path	Fur or Feathers	Other Sign
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							

WINTER FIELD TRIP -- THE RESULTS OF A WINTER WILDLIFE SURVEY

Following is a table of the distribution of wildlife identified either by sightings or by sign, by members of eight instructed fifth and sixth grade classes while on a late winter field trip.

Listed in the table are the numbers of classes that found evidence of the animal species in the various habitats surveyed.

Animal Species	Habitat Type - Each type is identified below					
	1	2	3	4	5	6
Bobwhite Quail	0	0	0	1	2*	0
Chipmunk	4*	0	0	2	4*	0
Cottontail Rabbit	2	8*	4	4	8*	4
Crow	2*	0	0	2*	2*	0
Deermouse	3	4*	0	2	4*	2
Gray Squirrel	8*	8*	2	3	4	0
Ground Squirrel	0	0	0	0	2*	0
Meadow Vole	0	0	0	2	4	7*
Raccoon	1	2	2	3*	0	0
Red Squirrel	2*	0	0	0	0	0
Red-winged Blackbird	0	2	4*	2	4*	4*
Ruffed Grouse	1*	0	0	0	0	0
Songbirds (variety)	2	0	2	0	8*	0
Weasel	2	2	2	2	4*	2
Whitetailed Deer	2	0	2	3	4*	2
Woodchuck	0	6*	4	3	4	4
Woodpecker (s)	8*	4	0	6	4	0

* indicates where animal evidence was found by the largest number of classes for each of the animal species.

Habitat Type

1 - Hardwood Woods with a few conifer trees.

2 - Margin of the woods and a brushy area.

3 - Margin of the brushy area and a weedy field.

4 - Area along a stream bank.

5 - Brushy hedgerow and/or a fence row with hardwood trees.

6 - Weedy field.

TABLE OF PROGRAM EVENTS AND TIME OF EVENT

TIME OF SELECTED PROGRAM EVENTS FOR EACH GROUP, EXPRESSED IN NUMBER OF DAYS AFTER ADMINISTRATION OF TEST ONE TO THE EXPERIMENTAL CLASSES

	5th Grade Students			6th Grade Students		
Events	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
Test One administered	032	000	000	032	000	000
First student attended Autumn A-T lessons	-	003	005	-	005	005
Last student attended Autumn A-T lessons	-	053	066	-	055	066
Test Two administered	-	054	066	-	056	066
Autumn Field Trip	-	054	067	-	059	068
Test Three administered	-	082	084	-	082	084
First student attended Winter A-T lessons	-	130	119	-	131	125
Last student attended Winter A-T lessons	-	181	178	-	178	179
Test Four-A administered	194	181	-	195	178	-
Winter Field Trip	-	182	178	-	185	180
Test Four-B administered	-	-	189	-	-	189
First student attended Spring A-T lessons	-	214	208	-	208	213
Last student attended Spring A-T lessons	-	238	241	-	242	238
Test Five-A administered	243	-	242	243	-	242
Spring Field Trip	-	244	252	-	243	257
Test Five-B administered	-	245	-	-	245	-

APPENDIX II

EVALUATION MATERIALS

TEST ONE - QUESTIONS AND INSTRUCTIONS TO THE TEACHER

ENVIRONMENTAL EDUCATION AUDIO-TUTORIAL LESSONS

STUDENT PRE-INVENTORY FALL PROGRAM

General Instructions to the Home Room Teacher or Core Room Teacher

1. Please describe this experience as a "Pre-inventory device" in environmental education -- as a tool that will help Mr. Presnell determine how to improve the audio-tutorial lessons for the Fall program.

2. Although I would prefer that the students use pencils, they may use either pencils or pens.

3. Please allow the students to look through their answer books for a minute before you begin. They should find a cover page on top, followed by three pages with space provided for sets of three or four answers on each page.

4. Please ask the students to then fill out the information requested on the cover page. They are asked to write in the following information in the spaces provided:

   a. name
   b. home room or core room teacher's name
   c. an "x" to show whether they are in the morning or afternoon home room or core room.
   d. grade level
   e. date

5. The questions are listed on the following pages of the General Instructions. They are not found in the students' answer books.

6. Please give the students -- all students, regardless of ability and need -- approximately two minutes to answer each question, AFTER you have read the question twice. (SEE 3.)

7. Please ask the students to NOT return to a question after you have begun to read the next question.

8. Many questions are composed of several parts. If it is obvious that the two minute time limit is grossly insufficient for a given question, please allow additional time for that question, NOT to exceed four minutes.

9. Mr. Presnell will come to your room to pick up the preinventory materials within a few days after you have administered the tool. If a student has missed the pre-inventory, she or he will be allowed to take it at a later date.

PLEASE BE CERTAIN THE STUDENTS UNDERSTAND THAT THERE WILL BE A TIME LIMIT ON EACH QUESTION.

AFTER YOU HAVE REPEATED A QUESTION ONCE, PLEASE NOTE THE TIME, AND RECORD THE TIME ALLOWED FOR EACH QUESTION FOR EACH CLASS TO WHICH THIS PRE-INVENTORY IS ADMINISTERED.

QUESTIONS

1. IN THE ANSWER SPACE FOR QUESTION 1., PLEASE WRITE THE NAMES OF SOME THINGS THAT BOTH PLANTS AND ANIMALS NEED TO STAY ALIVE AND HEALTHY.

   Class______Time______, Class______Time______.

2. IN THE ANSWER SPACE FOR QUESTION 2., THERE IS A "CIRCLE PICTURE" OF THE SUN.
   SOMEWHERE NEAR THE SUN PICTURE, DRAW A "CIRCLE PICTURE" OF THE EARTH.
   SHOW WHERE IT IS NIGHT TIME ON YOUR EARTH PICTURE AND LABEL THAT PART OF YOUR EARTH PICTURE WITH THE LETTER "N" FOR NIGHT.
   SHOW WHERE IT IS DAY TIME ON YOUR EARTH PICTURES, AND LABEL THIS PART OF YOUR PICTURE WITH THE LETTER "D" FOR DAYTIME.

   Class______Time______, Class______Time______.

3. THERE IS A PICTURE OF A PLANT IN THE ANSWER SPACE FOR QUESTION 3. THE ROOTS, SOME BRANCHES, AND SOME LEAVES OF THE PLANT ARE LABELED.
   DRAW AN ARROW TO A PART OF THE PLANT WHERE MOST OF THE WATER THE PLANT USES, ENTERS THE PLANT. LABEL THIS ARROW "E" FOR "ENTER".
   DRAW ANOTHER ARROW OR ARROWS TO A PART OR PARTS WHERE MOST OF THE WATER LEAVES THE PLANT. LABEL THIS ARROW OR ARROWS, "L".

   Class______Time______, Class______Time______.

4. IT IS MUCH WARMER OUTDOORS IN THE SUMMER WHERE YOU LIVE, THAN IT IS IN THE WINTER. IN THE SPACE PROVIDED FOR ANSWER 4., TELL WHY IT IS WARMER IN THE SUMMER AND COLDER IN THE WINTER.

   Class______Time______, Class______Time______.

5. THE FRUITS OR SEEDS OF SOME PLANTS ARE BUILT LIKE TINY PARACHUTES. THE FRUITS OR SEEDS OF MANY OTHER PLANTS STICK TO YOUR CLOTHING AND TO ANIMAL FUR. WHY DO MANY PLANTS GROW PARACHUTE-LIKE FRUITS OR SEEDS, OR "STICK-TO-YOU" BURR-LIKE FRUITS OR SEEDS?

   Class______Time______, Class______Time______.

6. THERE IS A "CIRCLE PICTURE" OF THE SUN IN THE ANSWER SPACE FOR QUESTION 6. FOR THIS QUESTION YOU WILL BE ASKED TO DRAW AND LABEL FOUR "CIRCLE PICTURES" OF THE EARTH.
    DRAW ONE EARTH PICTURE TO SHOW THE EARTH IN THE WINTER -- LABEL IT "W".
    DRAW A SECOND EARTH PICTURE TO SHOW THE EARTH IN THE SPRING -- LABEL IT "SP".
    DRAW A THIRD EARTH PICTURE TO SHOW THE EARTH IN THE SUMMER -- LABEL IT "SU".
    DRAW A FOURTH EARTH PICTURE TO SHOW THE EARTH IN THE AUTUMN -- LABEL IT "A".

Class______Time______, Class______Time______.

7. THERE IS A PICTURE OF A YOUNG TREE IN THE SPACE FOR ANSWER 7. THE ROOTS, AND SOME LEAVES AND BRANCHES ARE LABELED. BUDS CAN BE FOUND ON BUSHES AND TREES. DRAW SIX OR MORE TINY CIRCLES ON PLACES ON THE PLANT PICTURE WHERE YOU WOULD EXPECT TO FIND SOME BUDS. ON THE LINE NEAR THE PLANT PICTURE, WRITE WHEN -- DURING WHAT SEASON OR TIME OF THE YEAR -- THE BUDS WOULD HAVE GROWN LARGE ENOUGH SO THAT YOU COULD SEE THEM WITHOUT THE AID OF A MAGNIFYING GLASS.

Class______Time______, Class______Time______.

8. ANIMALS SUCH AS CHIPMUNKS, SQUIRRELS, DUCKS, BUTTERFLIES, KATYDIDS, AND MANY, MANY, MORE DO THINGS TO PREPARE FOR WINTER. IN THE ANSWER SPACE FOR QUESTION 8., ANSWER THE QUESTION: "WHAT TELLS ANIMALS THAT WINTER IS COMING?"

Class______Time______, Class______Time______.

9. MANY PLANTS PRODUCE SEEDS AT SOME TIME DURING THEIR LIVES. IN "SPACE A" ANSWER THE QUESTION: "WHAT ARE SEEDS FOR?" IN "SPACE B" ANSWER THE QUESTION: "IN WHAT PART OF THE PLANT DO THE SEEDS DEVELOP?"

Class______Time______, Class______Time______.

10. THERE ARE THREE PICTURES, LABELED "A", "B", AND "C", OF THE SAME CABIN AND TREE IN THE SPACE FOR ANSWER 10. IN PICTURE "A", THE SUN IS SHOWN WHERE IT WOULD BE SEEN AT 10 O'CLOCK ON A FALL DAY.
    YOU DRAW A PICTURE OF THE SUN IN PICTURE "B" TO SHOW WHERE IT WOULD BE SEEN AT 10 O'CLOCK ON A WINTER DAY.
    THEN DRAW A PICTURE OF THE SUN IN PICTURE "C" TO SHOW WHERE IT WOULD BE SEEN AT 10 O'CLOCK ON A SUMMER DAY.

Class______Time______, Class______Time______.

11. MANY DIFFERENT KINDS OF ANIMALS LIVE AROUND HERE. YOU CAN FIND SQUIRRELS, PHEASANTS, BULLFROGS, GRASS-HOPPERS, SUNFISH, WOODPECKERS, WOODCHUCKS, AND MANY MORE. IN THE SPACE FOR ANSWER 11., LIST AS MANY DIFFERENT KINDS OF PLACES WHERE ANIMALS ARE FOUND AROUND HERE.

Class______Time______, Class______Time______.

12. LEAVES FALL FROM MAPLE TREES, HICKORY TREES, BIRCH TREES, ELM TREES, CHERRY TREES, AND MANY OTHER TREES IN THE AUTUMN. IN THE ANSWER SPACE FOR QUESTION 12., TELL WHY SUCH TREES LOSE THEIR LEAVES IN THE FALL.

Class______Time______, Class______Time______.

TEST ONE - STUDENTS' ANSWER BOOKLET

STUDENT'S COPY

ENVIRONMENTAL EDUCATION AUDIO-TUTORIAL LESSONS

FALL PROGRAM PRE-INVENTORY

COVER PAGE

YOUR NAME ____________________

YOUR TEACHER'S NAME ____________________

MORNING CLASS ______ AFTERNOON CLASS ________

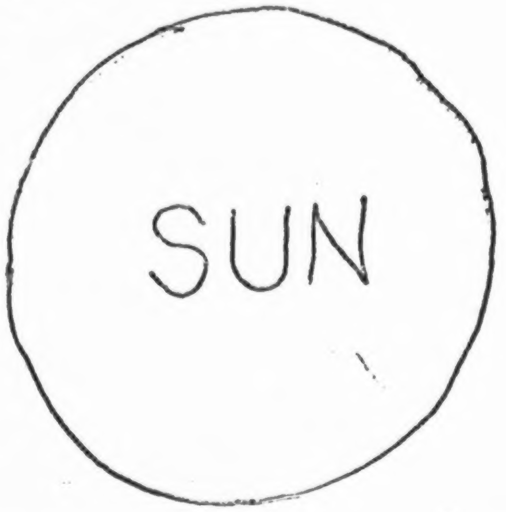
YOUR GRADE IN SCHOOL ____________________

TODAY'S DATE ____________________

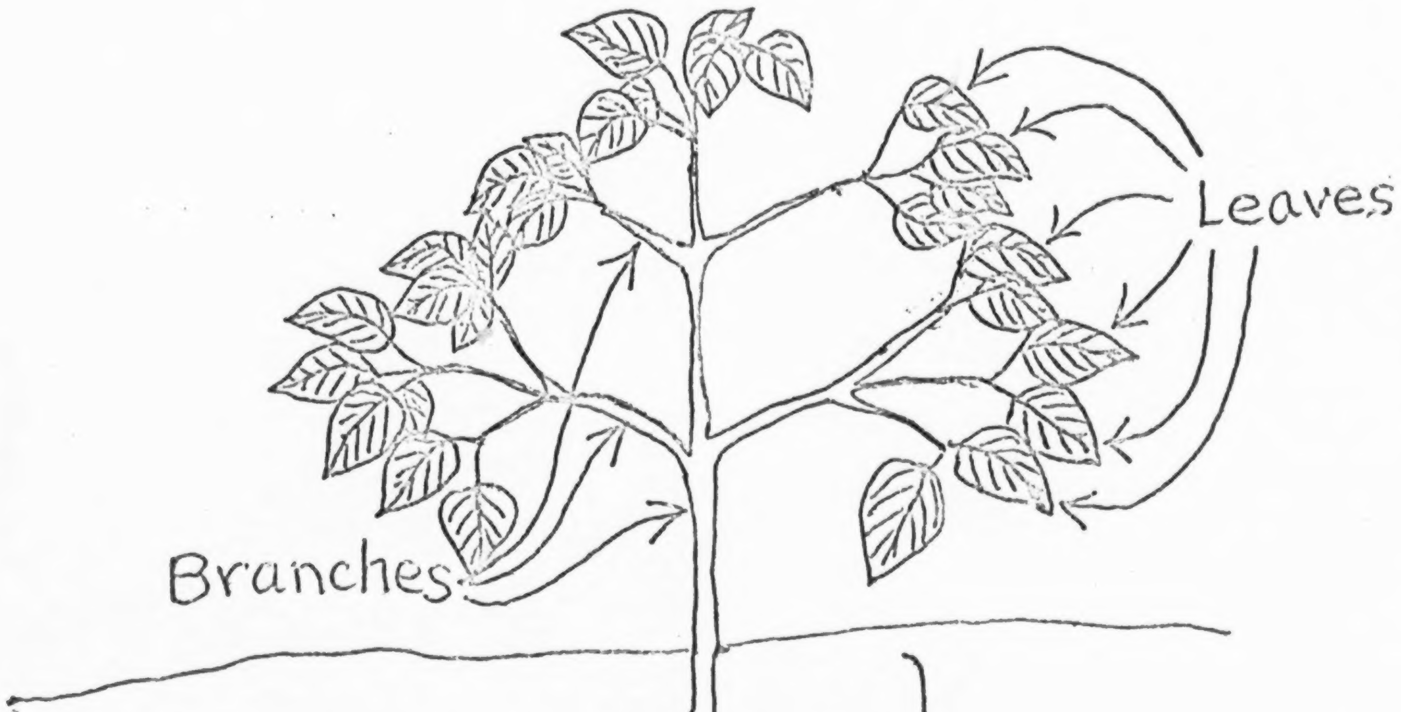
LOOK THROUGH THIS BOOKLET IF YOU LIKE. AFTER THIS PAGE, YOU SHOULD HAVE THREE MORE PAGES.

ANSWER SPACE FOR QUESTION 1.

ANSWER SPACE FOR QUESTION 2.



ANSWER SPACE FOR QUESTION 3.

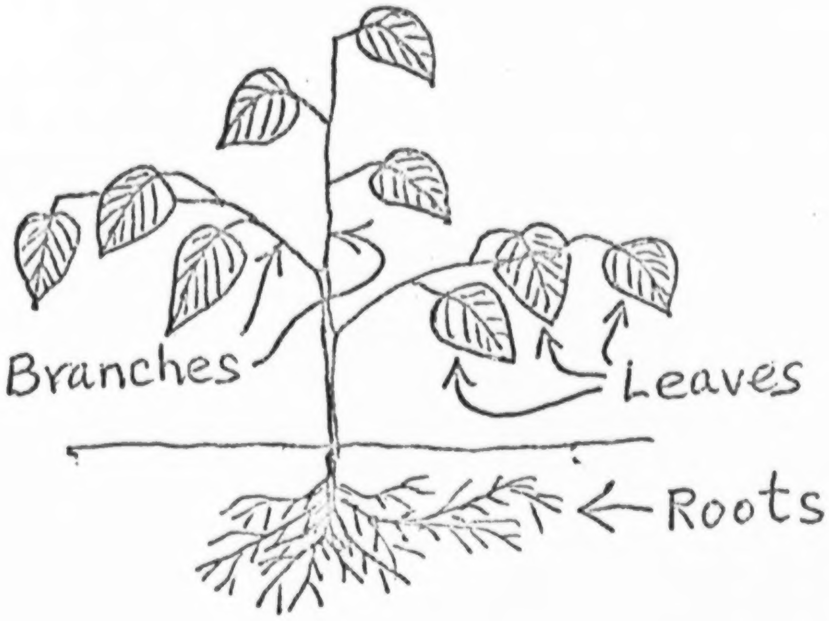

Leaves
Branches
Roots

ANSWER SPACE FOR QUESTION 4.

ANSWER SPACE FOR QUESTION 5.

ANSWER SPACE FOR QUESTION 6.

ANSWER SPACE FOR QUESTION 7.


Branches
Leaves
Roots

WHEN ____________

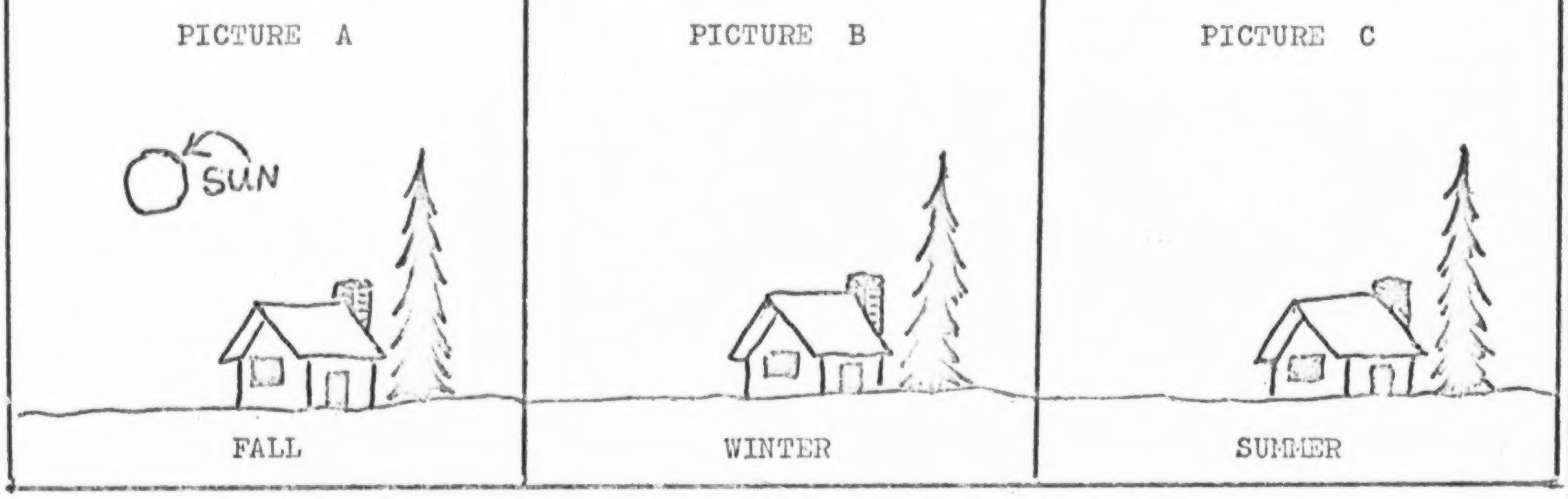
ANSWER SPACE FOR QUESTION 8.

ANSWER SPACE FOR QUESTION 9.

SPACE A

SPACE B

ANSWER SPACE FOR QUESTION 10.


PICTURE A
SUN
FALL
PICTURE B
WINTER
PICTURE C
SUMMER

ANSWER SPACE FOR QUESTION 11.

ANSWER SPACE FOR QUESTION 12.

TEST TWO - QUESTIONS AND INSTRUCTIONS TO THE TEACHER

ENVIRONMENTAL EDUCATION AUDIO-TUTORIAL LESSONS

STUDENT PRE-FIELD TRIP INVENTORY FALL LESSONS

General Instructions to the Home Room or Core Room Teacher:

1. Please describe this experience as a "Pre-field trip inventory device" in environmental education -- as a tool that will help Mr. Presnell determine how to improve the environmental education lessons, and help him plan for the Autumn field trip.

2. Although I would prefer that the students use pencils, they may use either pencils or pens.

3. Please allow the students to look through their answer books for a minute before you begin. They should find a cover page on top, followed by three pages with spaces provided for sets of 3 or 4 answers on each page.

4. Please ask the students to then fill out the information requested on the cover page. They are asked to write in the following information:

   a. name
   b. home room or core room teacher's name
   c. an "x" to show whether they are taking the inventory in the morning or in the afternoon
   d. their grade level
   e. date

5. The inventory questions are listed on the following pages of the General Instructions. Nine of the twelve questions are the same, or almost the same questions that the students were asked to answer of the pre-lesson inventory. The questions are not found in the students' answer books.

6. Please give the students -- regardless of ability and need -- approximately two minutes to answer each question, AFTER you have read the question twice.

7. Please ask the students NOT to return to a question after you have begun to read the next question.

8. Some questions are composed of several parts. If it is obvious that the two minute time limit is grossly insufficient for a given question, please allow additional time for that question, NOT TO EXCEED 4 minutes.

9. Mr. Presnell will come to your room to pick up the inventory materials within a few days after you have administered the tool. If a student has missed the inventory, she or he will be allowed to take it at a later date.

Please be certain the students understand that there will be a time limit on each question. After you have repeated a question once, please note the time and record the time allowed for each question for each class to which the inventory is administered. Thank you.

QUESTIONS

1. IN THE ANSWER SPACE FOR QUESTION1., PLEASE WRITE THE NAMES OF SOME THINGS THAT BOTH PLANTS AND ANIMALS NEED TO STAY ALIVE AND HEALTHY. WRITE OR LIST AS MANY THINGS YOU CAN THINK OF IN THE TIME GIVEN TO YOU.

Class ______________ Time __________ Class ____________ Time _________

2. IN THE SPACE FOR QUESTION 2., WRITE DOWN ALL THE EVIDENCE OR "SIGNS" YOU THINK YOU MIGHT FIND OUTDOORS, OF PLANTS PREPARING FOR WINTER.

Class ______________ Time __________ Class ____________ Time _________

3. THERE IS A PICTURE OF A PLANT IN THE ANSWER SPACE FOR QUESTION 3. THE ROOTS, SOME BRANCHES, AND SOME LEAVES OF THE PLANT ARE LABELED. DRAW AN ARROW TO A PART OF THE PLANT WHERE MOST OF THE WATER THE PLANT TAKES IN, ENTERS THE PLANT. LABEL THIS ARROW "E" FOR "ENTER." DRAW ANOTHER ARROW OR ARROWS TO A PART OR PARTS WHERE MOST OF THE WATER LEAVES THE PLANT. LABEL THIS ARROW OR ARROWS, "L."

Class ______________ Time __________ Class ____________ Time _________

4. IT IS MUCH WARMER OUTDOORS IN THE SUMMER WHERE YOU LIVE, THAN IT IS IN THE WINTER. IN THE SPACE FOR ANSWER 4., TELL WHAT CAUSES IT TO BE WARMER IN THE SUMMER AND COLDER IN THE WINTER.

Class ______________ Time __________ Class ____________ Time _________

5. THE FRUITS OR SEEDS OF SOME PLANTS ARE BUILT LIKE TINY PARACHUTES. THE FRUITS OR SEEDS OF SOME PLANTS STICK TO YOUR CLOTHING AND TO ANIMAL FUR. WHAT PURPOSE IS SERVED BY FRUITS OR SEEDS THAT STICK TO FUR OR FLY LIKE THEY HAD PARACHUTES?

Class ______________ Time __________ Class ____________ Time _________

6. IN THE SPACE FOR ANSWER 6., WRITE DOWN ALL THE EVIDENCE OR "SIGNS" YOU THINK YOU MIGHT FIND OUTDOORS, OF ANIMALS PREPARING FOR WINTER.

Class ______________ Time __________ Class ____________ Time _________

7. THERE IS A PICTURE OF A YOUNG TREE IN THE SPACE FOR ANSWER 7. THE ROOTS, AND SOME LEAVES AND BRANCHES ARE LABELED. BUDS CAN BE FOUND ON BUSHES AND TREES. DRAW SIX OR MORE TINY CIRCLES ON PLACES ON THE PLANT PICTURE WHERE YOU WOULD EXPECT TO FIND SOME BUDS. ON THE LINE NEAR THE PLANT PICTURE, WRITE WHEN -- DURING WHAT SEASON OR TIME OF THE YEAR -- THE BUDS WOULD HAVE GROWN LARGE ENOUGH SO THAT YOU COULD SEE THEM WITHOUT THE AID OF A MAGNIFYING GLASS.

Class______________Time_______ Class__________Time________

8. ANIMALS SUCH AS CHIPMUNKS, SQUIRRELS, DUCKS, BUTTERFLIES, KATYDIDS, AND MANY MANY MORE, DO THINGS TO PREPARE FOR WINTER. IN THE ANSWER SPACE FOR QUESTION 8., ANSWER THE QUESTION: "WHAT TELLS ANIMALS THAT WINTER IS COMING?"

Class_______________Time________ Class___________Time________

9. MANY PLANTS PRODUCE SEEDS AT SOME TIME DURING THEIR LIVES. IN "SPACE A" ANSWER THE QUESTION: "WHAT ARE SEEDS FOR?" IN "SPACE B", ANSWER THE QUESTION: "IN WHAT PART OF THE PLANT DO SEEDS DEVELOPE?"

Class______________Time__________ Class_____ _____Time__________

10. THERE ARE THREE PICTURES, LABELED "A", "B", AND "C", OF THE SAME CABIN AND TREE IN THE SPACE FOR ANSWER 10. IN PICTURE "A", THE SUN IS SHOWN WHERE IT WOULD BE SEEN AT 10 O'CLOCK ON A FALL DAY. YOU DRAW A PICTURE OF THE SUN IN PICTURE "B", TO SHOW WHERE IT WOULD BE SEEN AT 10 O'CLOCK ON A WINTER DAY. THEN DRAW A PICTURE OF THE SUN IN PICTURE "C", TO SHOW WHERE IT WOULD BE SEEN AT 10 O'CLOCK ON A SUMMER DAY.

Class______________Time__________ Class_____________Time__________

11. IN THE SPACE FOR ANSWER 11., NAME AN MANY OUTDOOR ANIMALS -- BIRDS, MAMMALS, REPTILES, AMPHIBIANS, INSECTS, OR OTHER ANIMALS -- THAT YOU MIGHT FIND ON A WINTER OUTDOOR TRIP IN THE HILLS, VALLEYS, FIELDS, ROADSIDES, PONDS, AND STREAMS AROUND ENFIELD (DANBY).

Class______________Time__________ Class_____________Time__________

12. LEAVES FALL FROM MAPLE TREES, HICKORY TREES, BIRCH TREES, ELM TREES, CHERRY TREES, AND MANY OTHER TREES IN THE AUTUMN. IN THE ANSWER SPACE FOR QUESTION 12., TELL WHY SUCH TREES LOSE THEIR LEAVES IN THE FALL.

Class_____________Time__________Class_____________Time__________

TEST TWO - STUDENTS' ANSWER BOOKLET

STUDENT'S COPY

ENVIRONMENTAL EDUCATION AUDIO-TUTORIAL LESSONS

FALL PROGRAM PRE-FIELD TRIP INVENTORY

- - - - - COVER PAGE - - - - -

YOUR NAME ____________________

YOUR TEACHER'S NAME ____________________

MORNING CLASS ________ AFTERNOON CLASS ______

YOUR GRADE IN SCHOOL ____________________

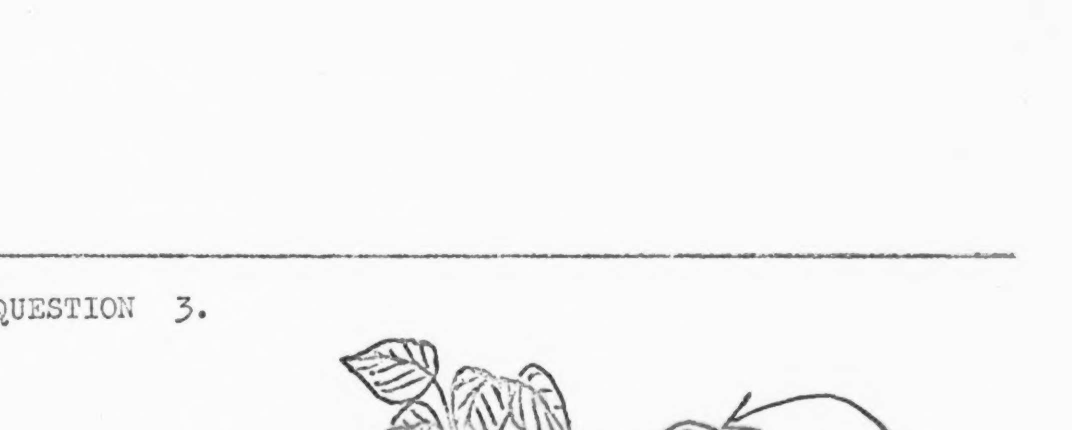
TODAY'S DATE ____________________

LOOK THROUGH THIS BOOKLET IF YOU LIKE. AFTER THIS PAGE, YOU SHOULD HAVE THREE MORE PAGES.

ANSWER SPACE FOR QUESTION 1.

ANSWER SPACE FOR QUESTION 2.

ANSWER SPACE FOR QUESTION 3.

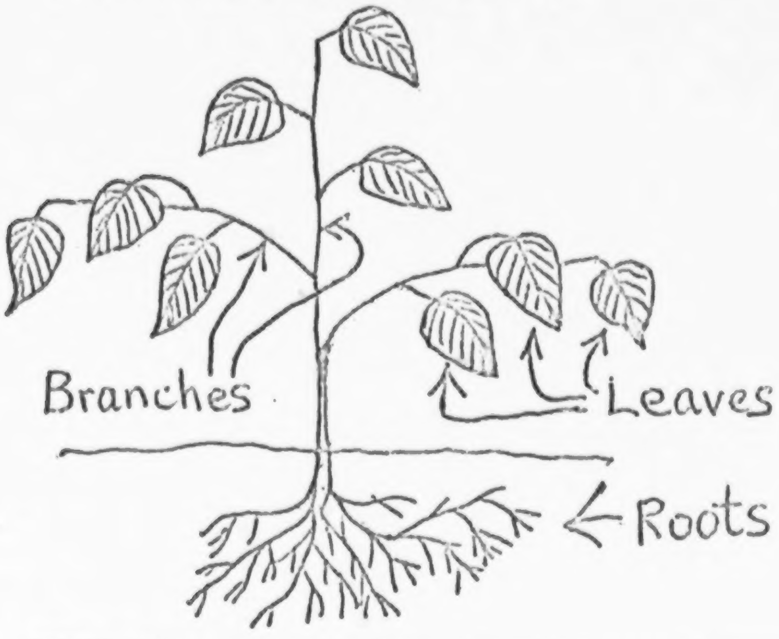

Leaves
Branches
Roots

ANSWER SPACE FOR QUESTION 4.

ANSWER SPACE FOR QUESTION 5.

ANSWER SPACE FOR QUESTION 6.

ANSWER SPACE FOR QUESTION 7.


Branches
Leaves
Roots

WHEN ______________

ANSWER SPACE FOR QUESTION 8.

TEST THREE - QUESTIONS AND INSTRUCTIONS TO THE TEACHER

ENVIRONMENTAL EDUCATION AUDIO-TUTORIAL LESSONS

STUDENT INVENTORY POST AUTUMN FIELD & PRE-WINTER LESSONS

General Instruction to the Home Room Teacher

1. Please describe this experience as a "Pre-winter lesson inventory device" in environmental education -- as a tool that will help Mr. Presnell determine how to improve the environmental education lessons for the winter program.

2. Although I would prefer that the students use pencils, they may use either pencils or pens.

3. Please let the students look through their answer books for a minute before you begin. They should find a cover page on top, followed by two pages with spaces provided for the twelve question responses.

4. Please ask the students to then fill out the information requested on the cover page. They are asked to write in the following:

   a. name
   b. homeroom or coreroom teacher's name
   c. their grade and section
   d. date
   e. an "x" ONLY IF THEY WERE NOT IN ATTENDANCE FOR THE FALL FIELD TRIP.

5. The inventory questions are listed on the following pages of the general instructions. Three of the twelve questions are the same as three of the questions the students were asked to answer on earlier inventories. The questions are not found in detail in the students' answer books.

6. Please give the students -- regardless of ability and need -- about two minutes to answer each question, AFTER you have read the question twice.

7. Please ask the students NOT to return to a question after you have begun to read the next question.

8. Some questions are composed of several parts. If it is obvious that the two minute time limit is grossly insufficient for a given question, please allow additional time for that question, NOT TO EXCEED 4 minutes.

9. Please be certain the students understand that there will be a time limit on each question. After you have repeated a question once, note the time and record the time allowed for each question for each class to which the inventory is administered.

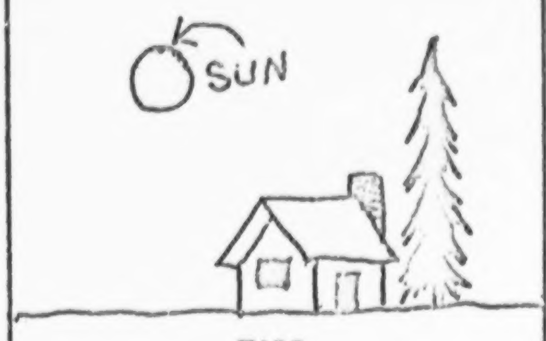
ANSWER SPACE FOR QUESTION 9.

SPACE A

SPACE B

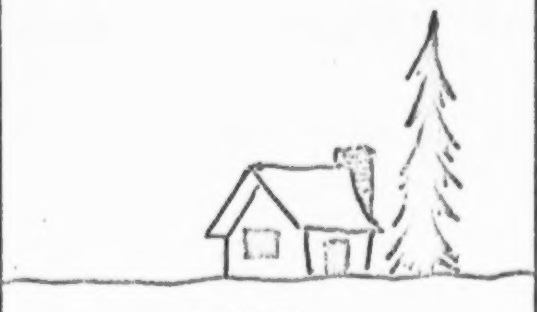
ANSWER SPACE FOR QUESTION 10.

PICTURE A



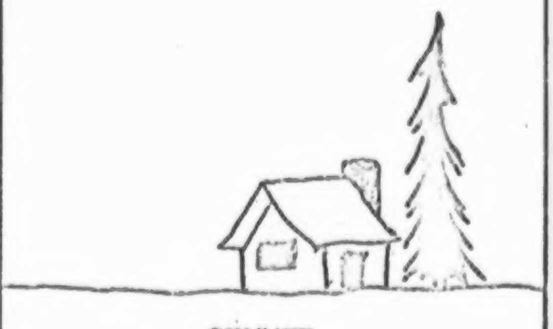
FALL

PICTURE B



WINTER

PICTURE C



SUMMER

ANSWER SPACE FOR QUESTION 11.

ANSWER SPACE FOR QUESTION 12.

10. Five questions, questions 8 through 12, require the use of a slide projector. Selected color slides are labeled and included with your inventory materials. The slides will be used by another teacher when your class is finished with them. If you insert the slides in the projector such that the red label number is on the upper right-hand corner, the pictures will appear in the correct orientation.

QUESTIONS

1. In the space for answer one, list some things that wild rabbits EAT outdoors in the winter.

Class ________ Time _______ Class ________ Time ________

2. In the space for answer two, write down all the EVIDENCE or SIGNS you might find outdoors now of PLANTS having prepared for WINTER.

Class ________ Time _______ Class ________ Time ________

3. In the space for answer three, list TWO OR MORE "LIFE REQUIREMENT MATERIALS" that wildlife might have trouble getting in the WINTER in this area.

Class ________ Time _______ Class ________ Time ________

4. In the space for answer four, write down all the EVIDENCE or SIGNS you think you might find outdoors now of LIVING THINGS having already prepared for SPRING.

Class ________ Time _______ Class ________ Time ________

5. In the space for answer five, tell WHAT PART of a plant grows into (or develops into) the FRUIT and SEEDS of the plant.

Class ________ Time _______ Class ________ Time ________

6. In the space for answer six, write down all the EVIDENCE or SIGNS you think you might find outdoors now of ANIMALS having prepared for WINTER.

Class ________ Time _______ Class ________ Time ________

7. There is a picture of a young tree in the space for answer 7. The roots, some leaves, and the branches are labeled. BUDS can be found on bushes and trees. DRAW SIX OR MORE tiny circles on PLACES on the plant picture where you would expect to find SOME BUDS. On the line near the plant picture, write WHEN -- during what SEASON or time of the year -- the buds would have grown large enough so that you could see them without the aid of a magnifying glass.

Class ________ Time _______ Class ________ Time _______

PLEASE REMIND THE CLASS TO CONTINUE TO REFRAIN FROM SPEAKING OUT LOUD DURING THE REMAINDER OF THE INVENTORY. IN MY EXPERIENCE, PROJECTED SLIDES SEEM TO STIMULATE VERBAL RESPONSES IN FIFTH AND SIXTH GRADE KIDS.

8. In the space for answer eight, write the NAME of the PLACE -- or HABITAT -- shown in the picture. THEN write the NAMES of animals you think you might find IN THAT HABITAT in the WINTER.

   Class ________ Time ________ Class ________ Time ________

9. There is MORE THAN ONE KIND of living place or habitat in this picture. Write NAMES that describe or name the kinds of habitats you see in this picture.

   Class ________ Time ________ Class ________ Time ________

10. In this picture, a TRACK of four footprints is shown in light snow. Write the NAME of the animal you think made this track.

    Class ________ Time ________ Class ________ Time ________

11. In this picture, a track of four footprints is also shown. Write the NAME of the animal you think made this track. The oak leaf in the picture will give you an idea of the size of the track.

    Class ________ Time ________ Class ________ Time ________

12. Shown in this picture is a tiny oak tree. An animal has visited this tree. Write the NAME of the animal you think has visited this tree, and then write WHY you think it was there.

    Class ________ Time ________ Class ________ Time ________

STUDENT'S COPY

ENVIRONMENTAL EDUCATION AUDIO-TUTORIAL LESSONS

WINTER PROGRAM POST FALL TRIP & PRE-LESSON INVENTORY

- COVER PAGE -

YOUR NAME ______________________________

YOUR TEACHER'S NAME ______________________________

YOUR GRADE IN SCHOOL __________ YOUR SECTION __________

TODAY'S DATE ______________________________

IF YOU DID NOT GO ON THE FALL FIELD TRIP WITH YOUR CLASS OR WITH SOME OTHER CLASS AT YOUR SCHOOL, MAKE AN "X" IN THE SPACE AT THE END OF THIS SENTENCE ______________

LOOK THROUGH THIS BOOKLET IF YOU LIKE. AFTER THIS PAGE YOU SHOULD HAVE TWO MORE PAGES.

ANSWER SPACE FOR QUESTION 1.

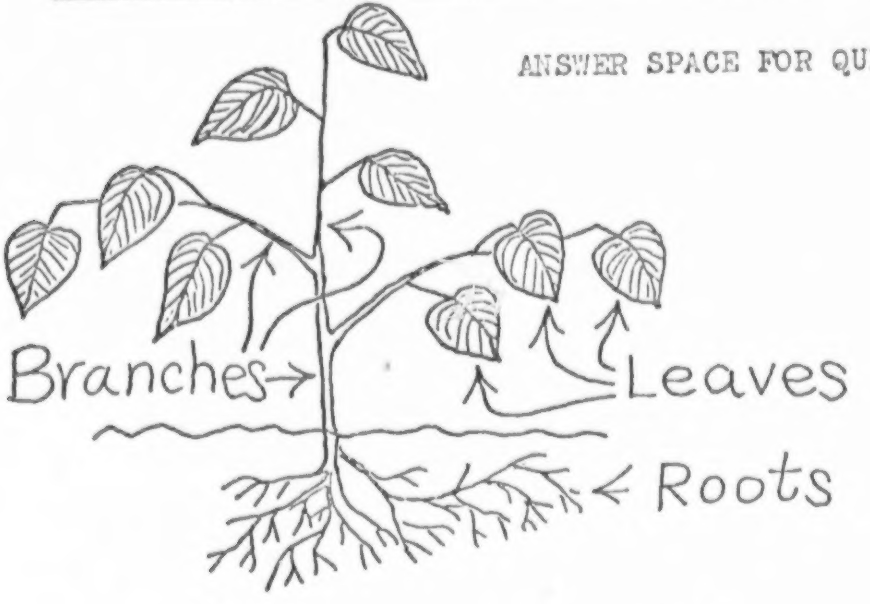
ANSWER SPACE FOR QUESTION 2.

ANSWER SPACE FOR QUESTION 3.

ANSWER SPACE FOR QUESTION 4.

ANSWER SPACE FOR QUESTION 5.

ANSWER SPACE FOR QUESTION 6.


Branches
Leaves
Roots

ANSWER SPACE FOR QUESTION 7.

WHEN ______________

ANSWER SPACE FOR QUESTION 8.

HABITAT ______________________ ANIMALS ______________________

____

____

ANSWER SPACE FOR QUESTION 9.

____

ANSWER SPACE FOR QUESTION 10.

____

ANSWER SPACE FOR QUESTION 11.

____

ANSWER SPACE FOR QUESTION 12.

ANIMAL NAME _______________ WHY WAS IT THERE? _______________

____

____

TEST FOUR-A AND FOUR-B - QUESTIONS AND INSTRUCTIONS TO TEACHERS

ENVIRONMENTAL EDUCATION AUDIO-TUTORIAL LESSONS

STUDENT INVENTORY POST WINTER LESSONS

General Instructions to the Homeroom Teacher

1. Please describe this experience as a "Post Winter Lesson Inventory" in environmental education -- as a tool that will help Mr. Presnell determine how well the winter lessons were designed and how he can improve the spring lessons coming later this year.

2. Although I would prefer that the students use pencils, they may use either pencils or pens.

3. Please let the students look through their answer books for a minute before you begin. They should find a cover page on top, followed by one page with spaces provided for the twelve question responses.

4. Please ask the students to fill out the information requested on the cover page of their answer books. They are asked to write in the following:
    a. Name
    b. Homeroom or coreroom teacher's name
    c. Grade
    d. Date
    e. An "X" if they have NOT played the wildlife ecology game titled, "How Was Your Winter?".

5. The inventory questions are listed on the following pages. Some questions are identical to questions asked on earlier inventories. The questions are not found in the students' answer books.

6. Please give the students -- regardless of ability and need -- about two minutes to answer each question, AFTER you have read the question twice.

7. Ask the students NOT to return to a question after you have begun to read the next question.

8. Some questions are composed of several parts. If it is obvious to you that the two minute limit is grossly insufficient for a given question, please allow additional time for that question, not to exceed four minutes.

9. Please be certain the students understand that there will be a time limit on each question. After you have repeated a question once, note the time and record the time allowed for each question for each class.

10. Seven questions (6 through 12) require the use of a slide projector. Selected color slides are labeled and included with your inventory materials. The slides will be used by another teacher when your classes are finished with them. If you insert the slides in the projector in the position that the red label number is on the upper right-hand corner, the pictures will appear in the correct orientation.

QUESTIONS

1. The THINGS ANIMALS DO IN THE SPRING -- that is, their SPRINGTIME ACTIVITIES AND BEHAVIOR -- are somewhat different from their activities during other seasons of the year. In the space for answer one, list things that you would call SPRINGTIME activities or behaviors of animals(such as birds, frogs, fishes, snakes, insects and the like.)

Class ________ Time ________ Class ________ Time ________

2. As spring comes, geese, ducks, and many other birds leave the warmer places where they lived during our cold winter. They fly back to this area and many fly even farther to areas in Northern Canada. WHAT TELLS these migratory birds that it IS TIME to leave their warm winter homes and return to the northern parts of North America?

Class ________ Time ________ Class ________ Time ________

3. In the space for answer three, list TWO or MORE "LIFE REQUIREMENT MATERIALS" that wildlife might have trouble getting in the winter in this area where we live.

Class ________ Time ________ Class ________ Time ________

4. In the space for answer four, write down all the EVIDENCE or SIGNS you think you might find outdoors now of living things having already prepared for SPRING.

Class ________ Time ________ Class ________ Time ________

5. As spring comes, the weather becomes warmer in this area. The snow melts and many signs of spring start to appear. In time, the weather becomes so warm you can put away your winter clothing. WHAT CAUSES the weather to become warmer in the spring?

Class ________ Time ________ Class ________ Time ________

6. - 12. Questions six through twelve pertain to color slides labeled with corresponding numbers. Please remind the class to continue to refrain from speaking out loud during the remainder of the inventory.

6. Shown here is a male American Toad. Its throat looks like a bubble because it was singing when this picture was taken one spring night. WHY do toads and other amphibians sing during spring evenings?

Class ________ Time ________ Class ________ Time ________

7. Shown here is a pair of mallard ducks. The male is the more brightly colored one. This pair was in an area where there were plenty of good nesting sites for the ducks. WHAT HAPPENS to ducks and to duck populations in areas where the ducks DON'T FIND enough good nesting sites?

Class ________ Time ________ Class ________ Time ________

8. In the space for answer eight, write the NAME of the PLACE -- or HABITAT -- shown in picture eight. Then WRITE THE NAMES of animals you think you might find IN THAT PLACE or HABITAT in the WINTER.

Class ________ Time ________ Class ________ Time ________

9. Shown here is an adult or GROWN UP, insect. This kind of insect is often seen flying in this area during the warmer seasons.

If you know a NAME for this insect, write the NAME in the space for the first part of answer nine.

In the space for the second part of answer nine, write the name of the PLACE, or KIND OF PLACE, where you think this insect spent its childhood -- that is, the kind of place WHERE it grew up while growing and developing into an adult.

Class ________ Time ________ Class ________ Time ________

10. Look at the orange colored Lily flower in the center of this picture. Now look just below the orange lily flower, at the spotted BABY DEER or FAWN. You may be able to see the fawn's ears and its left eye just below the bright spot sunlight.

In the space for answer ten, tell WHY deer give birth to fawns in the SPRING, rather than at other times of the year. (NOTE TO THE TEACHER: TO AVOID DISTRACTION, PLEASE TURN OFF THE PROJECTOR FOR THIS QUESTION WHILE THE STUDENTS ARE ANSWERING THIS QUESTION.)

Class ________ Time ________ Class ________ Time ________

11. In this picture, a track of four footprints is shown. The oak leaf in the picture will give you an idea of the size of the track. Write the NAME of the animal you think made this track. THEN write the word "hop" if you think this animal hops, OR write the word "walk" if you think this animal walks. The track shown here should help you tell whether the animal hops or walks.

Class ________ Time ________ Class ________ Time ________

12. A branch of a Red Maple tree is shown in this picture. The picture was taken in this area on an April day a few years ago. In the space for the first part of answer twelve, tell WHAT the red-orangish colored things ARE that are on the branch.

In the space for the second part of answer twelve, answer the following SPRINGTIME question -- it has little or nothing to do with the picture of the Red Maple branch.

Many animals are born (or hatched) in the spring. Some don't live long enough to grow into adults. WHAT LIFE REQUIREMENT MATERIAL is MOST IMPORTANT to the health and survival of new spring animal babies?

Class ________ Time ________ Class ________ Time ________

STUDENT COPY

ENVIRONMENTAL EDUCATION AUDIO-TAPED LESSONS

WINTER PROGRAM POST WINTER INVENTORY

- - - - COVER PAGE - - - -

YOUR NAME ______________________________

YOUR TEACHER'S NAME ______________________

YOUR GRADE OR CLASS IN SCHOOL ______________

TODAY'S DATE ___________________________

IF YOU HAVE NOT PLAYED THE WILDLIFE ECOLOGY GAME CALLED "How Was Your Winter?", MAKE AN "X" HERE __________

LOOK THROUGH THIS BOOKLET IF YOU LIKE.

AFTER THIS PAGE YOU SHOULD HAVE ONE MORE PAGE.

(1.) ____________________

(2) ____________________

(3) ____________________

(4) ____________________

(5) ____________________

(6) ____________________

(7) ____________________

(8) HABITAT (8) ANIMALS

(9) INSECT NAME (9) KIND OF PLACE

(10) ____________________

(11) ____________________

(12) FIRST PART (12) SECOND PART

TESTS FIVE-A AND FIVE-B - QUESTIONS AND INSTRUCTIONS TO TEACHERS

ENVIRONMENTAL EDUCATION	AUDIO-TUTORIAL LESSONS
STUDENT INVENTORY	FINAL INVENTORY

General Instructions to the Homeroom Teacher

1. Please describe this experience as a "Post Spring Lessons Inventory" in environmental education -- as a tool that will help Mr. Presnell determine how well the spring lessons were designed and what kinds of information students learned from the entire year program in environmental education.

2. Although I would prefer that the students use pencils, they may use either pencils or pens.

3. Please let the students look through their answer books for a minute before you begin. They should find a cover page, followed by one page with spaces provided for question responses.

4. Please ask the students to fill out the information requested on the cover page of their answer books. They are asked to write in the following information:

   a. Name
   b. Homeroom or coreroom teacher's name
   c. Grade
   d. Date

5. The inventory questions are listed on the following pages. All are identical to questions asked on one or more previous student inventories.

6. Please give the students -- regardless of ability and need -- about two minutes or less, to answer each question, AFTER you have read the question twice.

7. Ask the students NOT to return to a question after you have begun to read the next question.

8. Some questions are composed of several parts. If it is obvious to you that the two minute limit is grossly insufficient for a given question, please allow additional time for that question, not to exceed four minutes.

9. Please be certain the students understand that there will be a time limit on each question. After you have repeated a question once, please note the time and record the time allowed for each question for each class.

QUESTIONS

1. In the answer space for question 1, please write the names of some things that BOTH plants and animals NEED to stay alive and healthy. Also in the answer space for question 1, please answer the question: "Do PEOPLE need the things that plants and animals need to stay alive and healthy?"

Class __________ Time ________ Class __________ Time ________

2. It is much warmer outdoors in the summer where you live than it is in the winter. In the space for answer 2, tell WHY it is warmer in the summer and colder in the winter.

Class __________ Time ________ Class __________ Time ________

3. The FRUITS or SEEDS of some plants are built like tiny parachutes. The fruits or seeds of many other plants stick to your clothing and to animal fur. WHAT PURPOSE is served by fruits or seeds that stick to fur, or that fly like they had parachutes?

Class __________ Time ________ Class __________ Time ________

4. There is a picture of a young tree in the space for answer 4. The roots, some leaves, and some branches are labeled. BUDS can be found on bushes and trees. DRAW six or more tiny circles on PLACES on the plant picture where you would expect to find some buds.

On the line near the plant picture, write WHEN -- during what season or time of the year -- the buds would have grown large enough so that you could see them without the aid of a magnifying glass.

Class __________ Time ________ Class __________ Time ________

5. Animals such as chipmunks, squirrels, ducks, butterflies, katydids, and many many more DO THINGS TO PREPARE for winter. In the space for answer 5, answer the question: "WHAT tells animals that winter is coming?"

Class __________ Time ________ Class __________ Time ________

6. Many plants produce seeds at some time during their lives. In the space for the first answer to question 6, answer the question: "WHAT are SEEDS for?" In the space for the second part of this question, answer the question: "IN WHAT PART OF THE PLANT do the seeds develop?"

Class __________ Time ________ Class __________ Time ________

7. In the space for question seven, there are three pictures labeled "A", "B", and "C", of the same cabin and tree. In picture "A", the sun is shown where it would be seen at 10 o'clock on a fall day.

YOU DRAW a picture of the SUN in picture "B" to show WHERE it would be seen at 10 o'clock on a WINTER day.

Then DRAW a picture of the sun in picture "C" to show WHERE it would be seen at 10 o'clock on a summer day.

Class __________ Time ________ Class __________ Time ________

8. As spring comes, geese, ducks, and many other birds leave the warmer places where they lived during our cold winter. They fly back to this area and many fly even farther to areas in Northern Canada. WHAT TELLS these migratory birds that it IS TIME to leave their warm winter homes and return to the northern parts of North America?

Class __________ Time ________ Class __________ Time ________

9. The THINGS ANIMALS DO IN THE SPRING -- that is, their SPRINGTIME activities and behavior -- are somewhat different from their activities during other seasons of the year. In the space for answer nine, list things that you would call SPRINGTIME activities or behaviors of animals such as birds, frogs, fishes, snakes, insects, and the like.

Class __________ Time ________ Class __________ Time ________

10. In the space for answer ten, tell why deer give birth to fawns in the spring, rather than at other times of the year.

Class __________ Time ________ Class __________ Time ________

11. In the space for answer eleven, tell WHY toads and other amphibians sing during spring evenings.

Class __________ Time ________ Class __________ Time ________

12. Leaves fall from maple trees, hickory trees, birch trees, elm trees, cherry trees, and many other trees in the autumn. In the answer space for question twelve, tell WHY such trees lose their leaves in the autumn.

Class __________ Time ________ Class __________ Time ________

TESTS FIVE - A AND FIVE - B - STUDENTS' ANSWER BOOKLET

STUDENT COPY

ENVIRONMENTAL EDUCATION AUDIO-TAPED LESSONS

SPRING PROGRAM FINAL INVENTORY

- COVER PAGE -

YOUR NAME ______________________________

YOUR TEACHER'S NAME ______________________

YOUR GRADE IN SCHOOL _____________________

TODAY'S DATE ____________________________

THE NAME OF YOUR SCHOOL __________________

MAKE AN "X" HERE ______ IF YOU HAVE COMPLETED ALL OF THE AUDIO-TAPED ENVIRONMENTAL EDUCATION LESSONS.

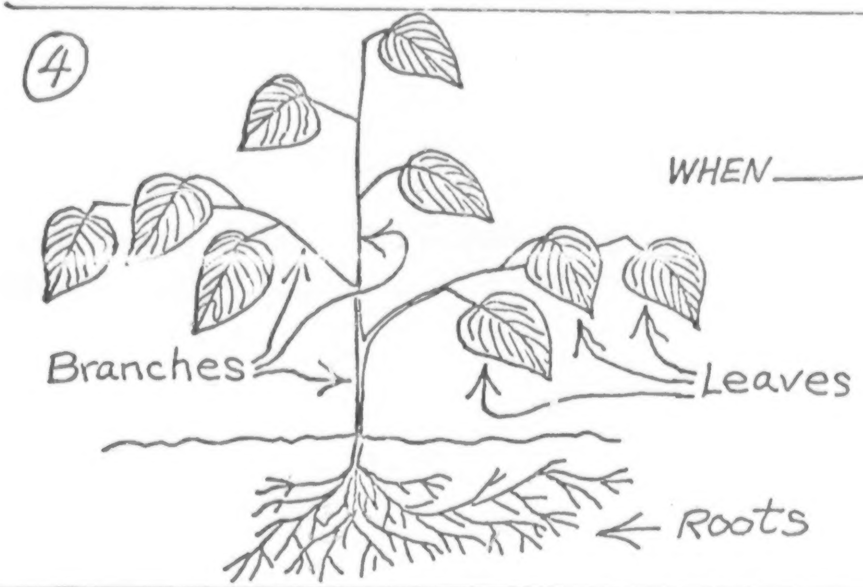
MAKE AN "X" HERE ______ IF YOUR CLASS HAS BEEN TAKEN ON THE SPRING FIELD TRIP ALREADY.

①

②

③

④


Branches
Leaves
Roots

WHEN________

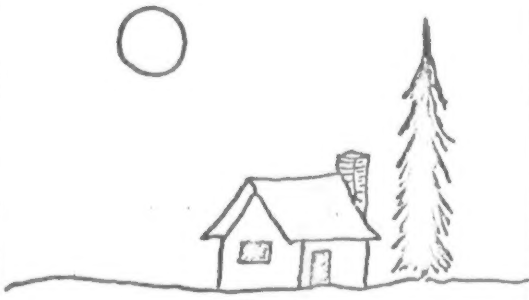
⑤

⑥ 1st Part

⑥ 2nd Part

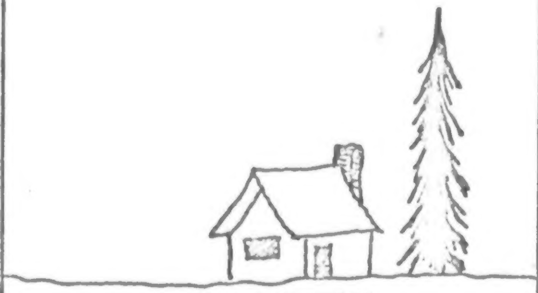
⑦

PICTURE A



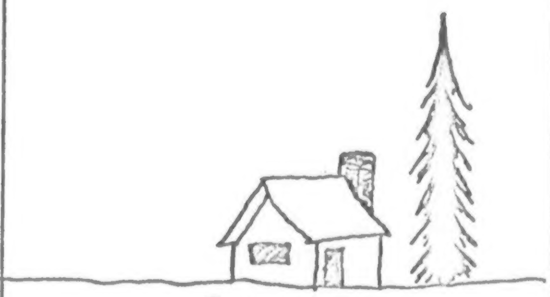
FALL

PICTURE B



WINTER

PICTURE C



SUMMER

⑧

⑨

⑩

⑪

⑫

STUDENT RESPONSES TO TEST ONE QUESTIONS

QUESTION ONE

MEAN SCORE FOR EACH GROUP OF STUDENTS

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
$\overline{X}$	1.59	1.64	2.03	2.39	2.41	2.22
N	27	22	35	14	27	31

A "score" for question one is the number of accepted answers given by a student, minus the number of unaccepted answers. The ten accepted answers, with acceptable variations, are given below:

1. Air or oxygen.
2. Energy, or food energy, or food.
3. Water.
4. Chemical elements, or elements, or minerals.
5. Vitamins.
6. Temperature range, or some general statement about temperature requirements.
7. Space, or living space.
8. Some general statement about the need of "other forms of life."
9. Sun or sun's energy.
10. Day and night.

FREQUENCY OF OCCURRENCE OF SELECTED COMMONLY OCCURRING ANSWERS TO QUESTION ONE, EXPRESSED AS PERCENT OF STUDENTS WHO GAVE EACH ANSWER

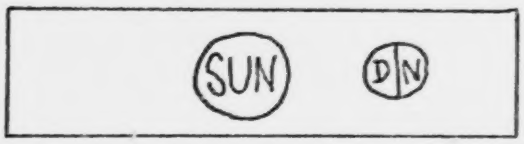
	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
Food	74.0	63.6	68.6	92.8	51.8	54.8
Air or oxygen	51.8	13.6	22.8	85.7	44.4	32.2
Water	100.0	95.5	80.0	92.8	85.2	87.1
Temperature Range	0.0	4.5	8.6	14.8	7.4	6.4
Space	3.7	0.0	2.9	0.0	3.7	3.2
Soil or Minerals	18.5	9.1	5.7	7.1	18.5	25.8
Sun	66.7	40.9	31.4	64.3	74.0	64.5

QUESTION TWO

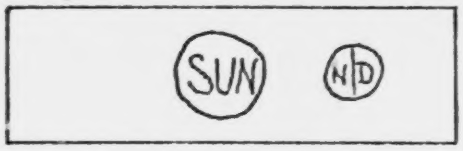
FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

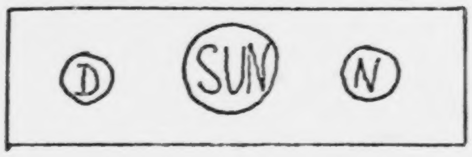
	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	37.0	59.1	82.8	78.6	66.7	70.9
2.	59.2	40.9	17.2	21.4	33.3	29.1
3.	3.7	0.0	0.0	0.0	0.0	0.0
N	27	22	35	14	27	31

The best responses are indicated by response 1 above, and include responses similar to the following:



Poor or incorrect responses are included in response 2 and include a variety of answers, most of which resemble one of the two following examples:





No response to question two is indicated in the table by response 3.

QUESTION THREE

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	55.5	40.9	60.0	85.7	63.0	54.8
2.	18.5	31.8	22.8	7.1	29.6	38.7
3.	25.9	22.7	17.2	7.1	7.4	5.7
4.	0.0	4.5	0.0	0.0	0.0	0.0
N	27	22	35	14	27	31

QUESTION THREE (Continued)

A completely correct response, indicating that the student labeled both water intake and exit parts correctly, is shown by response 1 above. Response 2 includes answers by students who could label water intake parts only. Incorrect responses to both parts of question three are indicated by response 3. Response 4 includes those students who did not answer either part of question three.

QUESTION FOUR

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	3.7	0.0	0.0	14.3	0.0	3.2
2.	3.7	0.0	0.0	14.3	0.0	0.0
3.	7.4	13.6	5.7	7.1	11.1	16.1
4.	40.7	18.2	20.0	28.6	25.9	29.0
5.	7.4	36.4	28.6	0.0	37.0	35.4
6.	29.6	18.2	20.0	28.6	14.8	6.4
7.	7.4	13.6	25.7	7.1	11.1	9.7
N	27	22	35	14	27	31

Response category 1 above is considered to be the best response, and response 6 is considered to be the least acceptable answer. Response 7 includes those students who did not answer question four.

Response 1 includes those students who indicated they thought the tilt of the earth (the fixed inclination of the earth's axis) was the primary cause of seasonal variation in earth seasonal temperatures.

Response 2 includes those who considered variation in daylength and inclination of impinging sunlight as causes for seasonal temperatures.

Response 3 above includes those students who considered either daylength or inclination of sunlight, or some statement was made to indicate they thought a greater amount of the sun's energy was absorbed by the earth during the warmer months.

QUESTION FOUR (Continued)

Response 4 includes answers that consider the sun as a casual agent, but either indicate that the student thinks the earth is closer to the sun during the warmer months, or that the sun is "stronger" or somehow more efficient during the summer.

Response 5 above includes the answers of students who, although they considered the sun's energy to be a causal agent in affecting earth temperatures, indicated that the sun was less effective in the winter because, "It is cloudy in the winter, and there are no (or few) clouds in the summer," or gave some other incorrect reason for the sun's greater effectiveness in the summer.

Response 6 answers do not imply that the sun is an influencing agent in seasonal variation of earth temperatures. Answers such as, "Snow makes it colder in winter," and "It is colder in the winter" are common examples of response 6 category answers.

QUESTION FIVE

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	3.7	0.0	2.8	7.1	3.7	3.2
2.	7.4	13.6	5.7	50.0	14.8	16.1
3.	11.1	0.0	8.6	14.3	40.7	29.0
4.	3.7	13.6	17.2	7.1	3.7	6.4
5.	74.0	72.8	65.7	21.4	37.0	45.2
N	27	22	35	14	27	31

Response 1 is considered to be the best response in the table above. This category includes answers that indicate the student considered seed dispersal to be a means of enhancing the possibility of seeds attaining sufficient space for future growth, and thereby increasing the probability of species survival.

Response 2 includes the answers of students who thought both seed dispersal and plant reproduction comprised the best answer, but did not elaborate further.

QUESTION FIVE (Continued)

Response 3 includes students' answers that considered plant dispersal or plant reproduction as the reason for traveling adaptations of seeds.

Response 4 includes a variety of incorrect answers, but answers written in a manner to suggest that the student understood the question.

Response 5 includes both no response students, and responses that suggest that the student did not understand the question.

QUESTION SIX

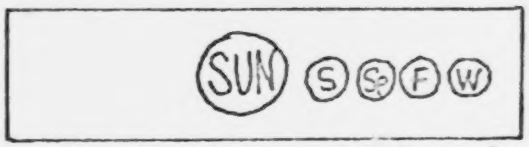
FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	33.3	63.6	68.4	57.0	44.4	70.9
2.	33.3	4.5	17.2	21.4	18.5	12.9
3.	33.3	27.3	11.4	21.4	33.3	16.1
4.	0.0	4.5	2.9	0.0	3.7	0.0
N	27	22	35	14	27	31

Response 1 is considered to be the best response for question six. For an answer to be placed here, the student had to label each of the four circle pictures of the earth, and have them positioned in the correct sequence, either clockwise or counter-clockwise in four quadrants around the labeled sun circle picture.

Response 2 includes all of the answer characteristics of response 1 answers, except that two of the seasonal positions were reversed in sequence.

Response 3 includes a variety of incorrect drawings, most of which resemble the following diagram:



Response 4 includes students that did not answer question six.

QUESTION SEVEN - FIRST PART

FREQUENCY OF RESPONSES, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	7.4	4.5	17.2	21.4	29.6	41.9
2.	3.7	4.5	8.6	0.0	14.8	9.7
3.	0.0	4.5	2.8	0.0	11.1	3.2
4.	0.0	9.1	2.8	0.0	22.2	9.7
5.	88.9	77.3	68.6	78.6	22.2	35.4
N	27	22	35	14	27	31

Response 1 includes students who drew six or more buds in place where terminal and/or axillary buds would be found on the plant in the diagram.

Response 2 includes students who drew buds in five legitimate places, and one or more in incorrect places.

Response 3 includes students who drew buds in four legitimate places, and two or more buds in incorrect places.

Response 4 includes those who drew buds in three correct places, and three or more buds in incorrect places.

Response 5 includes those students who drew buds in more illegitimate places than legitimate places, or who did not answer this part of the question.

QUESTION SEVEN - SECOND PART

FREQUENCY OF RESPONSES, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	29.6	63.6	62.8	14.3	70.3	41.9
2.	11.1	0.0	8.6	7.1	3.7	0.0
3.	59.2	27.3	20.0	78.6	25.9	58.1
4.	0.0	9.1	8.6	0.0	0.0	0.0
N	27	22	35	14	27	31

QUESTION SEVEN - SECOND PART (Continued)

In response category number 1 are included students who gave any of the following responses: Late spring, summer, early fall, or fall.

Response 2 includes those who gave either, "late fall" or "winter."

Response 3 includes all students who used "spring" as their answer.

Response 4 includes those who did not answer the second part of question seven.

QUESTION EIGHT

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	14.8	0.0	8.6	14.3	7.4	12.9
2.	0.0	0.0	0.0	0.0	3.7	0.0
3.	3.7	9.1	8.6	21.4	11.1	16.1
4.	7.4	9.1	17.2	0.0	11.1	0.0
5.	33.3	13.6	17.2	14.3	14.8	29.0
6.	37.0	59.1	37.1	50.0	48.1	41.9
7.	0.0	4.5	11.4	0.0	0.0	0.0
8.	3.7	4.5	0.0	0.0	3.7	0.0
N	27	22	35	14	27	31

Response 1 includes those students whose answers considered seasonal change in daylength as the primary clue or mechanism that "tells" animals that winter is coming.

Response 2 includes those who wrote of some biological clock type of internal timing device serving as the mechanism.

Response 3 for question eight, includes students who wrote that "instinct" was the cause and did not elaborate on their answers.

QUESTION EIGHT (Continued)

Response 4 students answered in a manner to indicate that they think animals receive clues to the coming of winter by seeing other animals and/or plants preparing for winter.

Response 5 includes those who gave a combination of response 4 and response 6 answers.

Response 6 includes students who answered that animals receive notice of the approach of winter from weather tactile clues, weather visual clues, or both. A typical answer in this category is, "They can tell because the weather gets cold," or "The snow tells them."

Response 7 includes all students who indicated by their responses that they did not understand the question.

Response 8 includes those who did not answer question number eight.

QUESTION NINE - FIRST PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	88.9	63.6	62.8	100.0	85.2	93.5
2.	3.7	22.7	28.6	0.0	7.4	6.4
3.	7.4	13.6	8.6	0.0	7.4	0.0
N	27	22	35	14	27	31

Students in response 1 category gave answers that indicated that they though the function of seeds is for reproduction or for the "growth" of new plants.

Response 2 includes students who gave a variety of answers indicating that they did not know what seeds are for.

Response 3 includes those who did not answer the first part of question nine.

QUESTION NINE - SECOND PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	14.8	9.1	20.0	50.0	11.1	41.9
2.	70.3	68.1	65.7	50.0	77.7	54.8
3.	14.8	22.7	14.3	0.0	11.1	3.2
N	27	22	35	14	27	31

Response 1 above includes students who answered with any of the following: Flowers, fruits, or cones. A few students, whose answers were included in this response category, mentioned the ovary of flowers.

Response 2 students gave a variety of incorrect answers. Most of the responses were names of plant parts other than those of the response 1 category, or were height positions such as, "Near the top."

Response 3 includes those who did not answer the second part of question nine.

QUESTION TEN - FIRST PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	40.7	36.4	48.6	71.4	29.6	58.1
2.	3.7	9.1	2.9	0.0	0.0	6.4
3.	7.4	27.3	5.7	7.1	22.2	12.9
4.	33.3	27.3	42.8	21.4	44.4	22.6
5.	14.8	0.0	0.0	0.0	3.7	0.0
N	27	22	35	14	27	31

QUESTION TEN - FIRST PART (Continued)

Response 1 is considered to be the best answer, response 4, the most inaccurate, and response 5 includes those students who did not answer the first part of question ten.

Response 1 includes students whose drawings indicated that they thought the winter sun is lower in the sky than the fall sun and is found in the same side (left side) of picture B.

Response 2 includes those whose drawings indicated that they thought the winter sun is lower than the fall sun, but drew their sun picture to the right, in the lower right quadrant of picture B.

Response 3 includes those who drew their winter sun picture either at the same position as that occupied in picture A by the autumn sun, or on a line at the same height either to the right or left of the autumn sun position.

Response 4 includes those students who drew the winter sun picture above the elevation of the autumn sun position, in either the upper left or upper right quadrants of picture B.

QUESTION TEN - SECOND PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	33.3	22.7	25.7	71.4	33.3	35.4
2.	14.8	31.8	31.4	7.1	22.2	29.0
3.	18.4	22.7	17.2	0.0	22.2	12.9
4.	25.9	22.7	25.7	21.4	22.2	22.6
5.	7.4	0.0	0.0	0.0	0.0	0.0
N	27	22	35	14	27	31

Response 1 is considered to be the best answer, response 4, the most inaccurate response, and response 5 includes those students who did not answer the second part of question ten.

QUESTION TEN - SECOND PART (Continued)

Response 1 includes those students whose drawings indicate that they thought the summer sun to be higher in the sky than the fall sun, and in the same side (left side) of the picture.

Response 2 includes those whose drawings indicated that they thought the summer sun to be higher than the fall sun, but drew their sun picture in the upper right quadrant of picture C.

Response 3 includes those who drew their summer sun picture either at the same position as that occupied by the fall sun in picture A, or on a line at the same elevation, either to the right or left of the fall sun position.

Response 4 includes those who drew their summer sun pictures below the elevation of the fall sun, in either the lower right or the lower left quadrants of picture C.

QUESTION ELEVEN

MEAN SCORE FOR EACH GROUP OF STUDENTS

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
$\overline{X}$	4.7	4.9	6.0	6.3	4.1	5.9
N	27	22	35	14	27	31

A score for question eleven is the number of accepted answers given by a student. The score was not influenced by "unacceptable" answers given. Acceptable answers include a wide range of items having the common characteristic of being either habitat types, microhabitat types, or ecosystems occuring in Upstate New York.

QUESTION TWELVE

Response 1 for question twelve (table below) is considered to be the best response. Response 6 is the poorest response, and response 7 includes all students who did not answer question twelve.

Response 1 includes those students whose answers indicated that they considered tree leaf loss to be a response to changing photoperiod.

Response 2 includes those who discussed abscission tissue development or the morphology and/or function of abscission tissue.

QUESTION TWELVE (Continued)

Response 3 includes those whose answers indicated that they believed old age, death of the leaves, some unexplained loss of function of the leaves, or some specific and named environmental condition rendering the leaves functionless, was the cause of leaf loss.

Response 4 includes those students whose answers were a combination of the criteria included in responses 3 and 5.

Response 5 includes those who considered some mechanical environmental factor such as wind, rain, frost, cold weather in general, or a combination of these to be the cause of leaf loss by deciduous plants in the autumn.

Response 6 includes students who gave the answers, "Because winter is coming," "Because they lose their leaves," or some other answer considered by the author to be unexplanatory or meaningless.

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	0.0	0.0	0.0	0.0	0.0	0.0
2.	0.0	0.0	0.0	0.0	0.0	3.2
3.	37.0	27.3	34.3	57.0	25.9	29.0
4.	14.8	0.0	0.0	7.1	3.7	9.7
5.	29.6	36.4	25.7	14.2	18.5	38.7
6.	7.4	36.4	22.8	21.4	37.0	19.3
7.	11.1	0.0	17.2	0.0	14.8	0.0
N	27	22	35	14	27	31

STUDENT RESPONSES TO TEST TWO QUESTIONS

QUESTION ONE

MEAN SCORE FOR EACH GROUP OF STUDENTS

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}$	2.48	2.42	2.84	2.23
N	21	36	25	31

Score criteria for question one, test two is identical to that used for question one, test one. The criteria are given on page 278.

QUESTION TWO

MEAN SCORE FOR EACH GROUP OF STUDENTS

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}$	1.14	1.16	1.56	1.90
N	21	36	25	31

A "score" for question two above, is the number of accepted answers given by a student minus the number of unaccepted answers. Accepted answers include the following:

1. Loss of leaves or death of leaves.
2. Buds have grown or buds have developed.
3. Leaves have changed color.
4. Death of some plants.
5. Seeds (and/or fruits) have grown or have developed.
6. Plants have stopped active growth.

QUESTION THREE

The response grouping used to categorize students' responses to question three, test two, is identical to the grouping used to categorize responses to question three, test one. The grouping criteria are given on page 280.

QUESTION THREE (Continued)

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
1.	33.4	66.7	64.0	64.5
2.	38.1	19.4	32.0	12.9
3.	19.1	13.8	4.0	22.6
4.	9.5	0.0	0.0	0.0
N	21	36	25	31

QUESTION FOUR

The response grouping used to categorize students' responses to question four, test two, is identical to the grouping used to categorize responses to question four, test one. The grouping criteria are given on page 280.

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
1.	4.8	2.8	4.0	35.4
2.	0.0	0.0	0.0	0.0
3.	23.8	11.0	16.0	12.9
4.	23.8	36.0	24.0	19.3
5.	14.3	25.0	12.0	16.1
6.	14.3	13.8	28.0	16.1
7.	19.1	11.0	16.0	0.0
N	21	36	25	31

QUESTION FIVE

The response grouping used to categorize students' responses to question five, test two, is identical to the grouping used to categorize responses to question five, test one. The grouping criteria are given on page 281.

FREQUENCY OF RESPONSE, EXPRESSED IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
1.	0.0	2.8	4.0	3.2
2.	14.3	16.6	24.0	48.4
3.	4.8	8.4	52.0	22.6
4.	9.5	11.0	0.0	0.0
5.	71.4	61.2	20.0	25.8
N	21	36	25	31

QUESTION SIX

MEAN SCORE FOR EACH GROUP OF STUDENTS

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}$	1.33	1.64	2.24	2.23
N	21	36	25	31

A "score" for question six is the number of accepted answers given by a student, minus the number of unaccepted answers. Ten accepted answers are given below:

1. Migration.
2. Hibernation.
3. Food storage.
4. Color change.
5. Growth of winter fur.
6. Preparation of lodges or dens.
7. Change in diet.
8. Development of a winter fat layer.
9. Mating season (select species).
10. Insect egg laying and/or pupating.

QUESTION SEVEN - FIRST PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
1.	19.1	33.3	52.0	67.7
2.	14.3	13.8	12.0	3.2
3.	19.1	11.0	4.0	3.2
4.	9.5	8.3	8.0	6.4
5.	38.1	33.3	24.0	19.3
N	21	36	25	31

The response grouping used to categorize students' responses to question seven - first part, test two, is identical to the grouping used to categorize responses to question seven - part one, test one. The grouping criteria are given on page 283.

QUESTION SEVEN - SECOND PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
1.	57.2	55.5	56.0	51.6
2.	0.0	8.4	0.0	3.2
3.	33.3	25.0	40.0	45.2
4.	9.5	11.0	4.0	0.0
N	21	36	25	31

The response grouping used to categorize students' responses to question seven - second part, test two, is identical to the grouping used to categorize responses to question seven - second part, test one. The grouping criteria are given on page 284.

QUESTION EIGHT

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
1.	28.6	11.0	20.0	9.7
2.	0.0	0.0	16.0	16.1
3.	4.8	13.9	4.0	6.4
4.	9.5	2.8	12.0	12.9
5.	28.6	36.0	12.0	22.6
6.	28.6	22.2	32.0	29.0
7.	0.0	0.0	0.0	0.0
8.	0.0	13.9	4.0	3.2
N	21	36	25	31

The response grouping used to categorize students' responses to question eight, test two, is identical to the grouping used to categorize responses to question eight, test one. The grouping criteria are given on page 284.

QUESTION NINE - FIRST PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
1.	81.0	83.4	88.0	87.1
2.	9.5	8.3	8.0	12.9
3.	9.5	8.3	4.0	0.0
N	21	36	25	31

QUESTION NINE - FIRST PART (Continued)

The response grouping used to categorize students' responses to question nine - first part, test two, is identical to the grouping used to categorize responses to question nine - first part, test one. The grouping criteria are given on page 285.

QUESTION NINE - SECOND PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
1.	0.0	27.7	32.0	25.8
2.	95.2	64.0	56.0	74.2
3.	4.8	8.3	12.0	0.0
N	21	36	25	31

The response grouping used to categorize students' responses to question nine - second part, test two, is identical to the grouping used to categorize responses to question nine - second part, test one. The grouping criteria are given on page 286.

QUESTION TEN - FIRST PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
1.	57.2	38.8	44.0	51.6
2.	4.8	11.1	4.0	3.2
3.	4.8	5.5	4.0	6.4
4.	33.3	44.4	44.0	38.7
5.	0.0	0.0	4.0	0.0
N	21	36	25	31

QUESTION TEN - FIRST PART (Continued)

The response grouping used to categorize students' responses to question ten - first part, test two, is identical to the grouping used to categorize responses to question ten - first part, test one. The grouping criteria are given on page 287.

QUESTION TEN - SECOND PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
1.	33.3	27.7	20.0	35.4
2.	23.8	30.5	20.0	25.8
3.	28.6	13.9	20.0	9.7
4.	14.3	27.7	40.0	29.0
5.	0.0	0.0	0.0	0.0
N	21	36	25	31

The response grouping used to categorize students' responses to question ten - second part, test two, is identical to the grouping used to categorize responses to question ten - second part, test one. The grouping criteria are given on page 287.

QUESTION ELEVEN

MEAN SCORE FOR EACH GROUP OF STUDENTS

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}$	3.53	3.00	3.56	3.55
N	21	36	25	31

QUESTION ELEVEN (Continued)

A "score" for question eleven is the number of accepted answers given by a student, minus the number of unaccepted answers. Accepted answers include the names of outdoor living animals, wild or domestic, active in Upstate New York in the winter.

QUESTION TWELVE

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
1.	0.0	8.3	4.0	9.7
2.	0.0	5.5	8.0	6.4
3.	14.3	30.6	12.0	19.3
4.	0.0	0.0	4.0	6.4
5.	47.6	19.4	28.0	16.1
6.	33.3	27.8	36.0	38.7
7.	4.8	8.3	8.0	3.2
N	21	36	25	31

The response grouping used to categorize students' responses to question twelve, test two, is identical to the grouping used to categorize responses to question twelve, test one. The grouping criteria are given on page 288.

STUDENT RESPONSES TO TEST THREE QUESTIONS

QUESTION ONE

MEAN SCORE FOR EACH GROUP OF STUDENTS

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}$	1.25	0.88	1.35	1.06
N	20	34	26	32

A "score" for question one is the number of accepted answers given by a student, minus the number of unaccepted answers. Five accepted answers with acceptable variations are given below:

1. Bark of shrubs (bushes) and trees.
2. Twigs of shrubs (bushes) and trees.
3. Buds of shrubs (bushes) and trees.
4. Corn, soybeans, wheat grains, and other domestic and natural fruits and seeds possibly available during the winter.
5. Selected (and named) herbaceous plants persisting in an edible form in the winter.

FREQUENCY OF OCCURRENCE OF SELECTED RESPONSES TO QUESTION ONE, EXPRESSED AS PERCENT OF STUDENTS WHO GAVE EACH RESPONSE

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
Bark	40.0	35.3	61.5	50.0
Buds	0.0	5.9	11.5	6.3
N	20	34	26	32

QUESTION TWO

Score criteria for question two, test three, are identical to those used for question two, test two. The criteria are given on page 290.

QUESTION TWO (Continued)

MEAN SCORE FOR EACH GROUP OF STUDENTS

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}$	1.45	0.79	1.31	1.66
N	20	34	26	32

QUESTION THREE

MEAN SCORE FOR EACH GROUP OF STUDENTS

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}$	1.75	1.71	1.58	1.72
N	20	34	26	32

A "score" for question three is the number of accepted answers given by a student, minus the number of unaccepted answers. Eight accepted answers, with accepted variations, are given below:

1. Energy, or food energy, or food.
2. Shelter, or cover, or protection in general.
3. Warmth, or something to indicate the need for a tolerable temperature range.
4. Water.
5. Space.
6. Air (selected aquatic species).
7. Chemical elements.
8. Vitamins.

QUESTION THREE (Continued)

FREQUENCY OF OCCURRENCE OF SELECTED RESPONSES TO QUESTION THREE, EXPRESSED AS PERCENT OF STUDENTS WHO GAVE EACH RESPONSE

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
Food	85.0	79.4	65.4	85.3
Shelter, Cover, etc.	15.0	44.1	15.4	17.7
Warmth, etc.	10.0	2.9	3.9	8.8
Water	55.0	38.2	34.6	47.0
Space	0.0	0.0	0.0	0.0
N	20	34	26	32

QUESTION FOUR

MEAN SCORE FOR EACH GROUP OF STUDENTS

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}$	0.55	0.82	0.65	0.72
N	20	34	26	32

A "score" for question four is the number of accepted answers given by a student, minus the number of unaccepted answers. Five accepted answers with acceptable variations are given below:

1. Plant buds present.
2. Seed dispersal, or seeds spread or shed.
3. Animals (select species) have breeding colors (plumage).
4. Mating season (select species of animals).
5. Dormant insect eggs and/or pupae.

QUESTION FIVE

The response grouping used to categorize students' responses to question five, test three, is identical to the grouping used to categorize responses to question nine - part two, of both tests one and two. The grouping criteria are given on page 286.

QUESTION FIVE (Continued)

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
1.	30.0	29.4	15.4	25.0
2.	45.0	47.0	50.0	53.1
3.	25.0	23.6	34.6	21.9
N	20	34	26	32

QUESTION SIX

MEAN SCORE FOR EACH GROUP OF STUDENTS

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\overline{X}$	1.45	1.77	1.62	2.00
N	20	34	26	32

Score criteria for question six, test three, are identical to those used for question six, test two. The criteria are given on page 292.

QUESTION SEVEN - FIRST PART

The response grouping used to categorize students' responses to question seven - first part, test three, is identical to the grouping used to categorize responses to question seven - part one, test one, and to question seven - part one, test two. The grouping criteria are given on page 283.

The frequency of response table for question seven - first part, test three, is on the following page.

QUESTION SEVEN - FIRST PART (Continued)

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
1.	70.0	35.3	57.7	59.3
2.	10.0	5.9	19.2	15.6
3.	0.0	8.8	3.8	3.1
4.	5.0	11.8	3.8	0.0
5.	15.0	38.2	15.4	21.9
N	20	34	26	32

QUESTION SEVEN - SECOND PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
1.	60.0	44.1	50.0	37.5
2.	0.0	0.0	3.8	9.4
3.	35.0	50.0	42.3	53.1
4.	5.0	5.9	3.8	0.0
N	20	34	26	32

The response grouping used to categorize students' responses to question seven - second part, test three, is identical to the grouping used to categorize responses to question seven - second part, test one and to question seven - second part, test two. The grouping criteria are given on page 284.

QUESTION EIGHT - FIRST PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
1.	10.0	2.9	0.0	3.1
2.	70.0	64.6	80.7	84.4
3.	20.0	14.7	7.7	6.3
4.	0.0	17.7	11.5	6.3
N	20	34	26	32

Response 1 is considered to be the best response in the table above. This category includes students who described the habitat either as an evergreen or conifer woods (or forest), or as some specific type of conifer woods -- such as "pine woods," or "spruce woods."

Response 2 includes those students who described the habitat as either a "forest," a "woods,"or a "woodlot."

Response 3 includes those who described the habitat as something other than the responses in categories 1 and 2. Response 3 answers were considered to be incorrect.

Response 4 includes those who did not answer question eight - part one.

QUESTION EIGHT - SECOND PART

MEAN SCORE FOR EACH GROUP OF STUDENTS

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\overline{X}$	1.50	1.97	1.82	1.69
N	20	34	26	32

A "score" for this question is the number of accepted answers given by a student, minus the number of unaccepted answers. Acceptable answers included all species of animals that might be expected to spend a majority of their active time in the mature spruce woodlot in the winter.

QUESTION NINE

MEAN SCORE FOR EACH GROUP OF STUDENTS

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
$\bar{X}$	2.00	1.29	1.46	2.10
N	20	34	26	32

A "score" for question nine, test three, is the number of accepted answers given by a student, minus the number of unaccepted answers. Accepted answers, including variations, are given below:

1. Spruce trees, pine trees, evergreen trees, conifer trees, or trees, woods, forest, or woodlot.
2. Bushes, brush, or shrubs.
3. Weeds, weedy field, grasses, or grassy field.
4. A variety of habitats named for animals that commonly inhabit them, such as, "squirrel habitat" or "rabbit habitat."

QUESTION TEN

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
1.	85.0	50.0	76.9	68.8
2.	5.0	2.9	0.0	9.4
3.	10.0	44.1	15.4	21.9
4.	0.0	2.9	7.7	0.0
N	20	34	26	32

Response 1 includes those students who correctly identified the rabbit tracks in the projected colored slide. Response 2 includes those who identified the tracks as squirrel tracks. Response 3 includes students who identified the tracks as having been made by some animal other than a rabbit or a squirrel. Response 4 includes those students who did not answer the question.

QUESTION ELEVEN

FREQUENCY OF RESPONSE, EXPRESSED IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
1.	75.0	26.5	53.8	28.1
2.	10.0	35.3	7.7	34.4
3.	15.0	35.3	34.6	34.4
4.	0.0	2.9	3.9	3.1
N	20	34	26	32

Response 1 includes those students who correctly identified the squirrel tracks in the projected colored slide. Response 2 includes those who identified the tracks as rabbit tracks. Response 3 includes students who identified the tracks as having been made by some animal other than a squirrel or a rabbit. Response 4 includes those students who did not answer the question.

QUESTION TWELVE - FIRST PART

FREQUENCY OF RESPONSE, EXPRESSED IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
1.	25.0	23.6	53.8	40.7
2.	45.0	55.8	34.6	56.2
3.	25.0	11.8	7.7	3.1
4.	5.0	8.8	3.9	0.0
N	20	34	26	32

Response 1 includes students who wrote that the rabbit browsed oak tree in the projected colored slide had been visited by a rabbit. Response 2 includes those students who wrote that the tree had been visited by a deer. Response 3 students wrote that it had been visited by some animal other than a rabbit or a deer. Response 4 includes students who did not answer the first part of question twelve.

QUESTION TWELVE - SECOND PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students		6th Grade Students	
	Danby School	Enfield School	Danby School	Enfield School
1.	80.0	85.3	88.4	90.6
2.	10.0	5.9	7.7	6.3
3.	10.0	8.8	3.9	3.1
N	20	34	26	32

Response 1 includes those students who wrote that the animal they thought had visited the young oak tree had been there to eat. This is considered to be the correct answer.

Response 2 includes students who wrote that the animal had visited the tree for one of a number of other reasons.

Response 3 includes students who did not answer the second part of question twelve.

STUDENT RESPONSES TO TESTS 4-A AND 4-B QUESTIONS

QUESTION ONE

MEAN SCORE FOR EACH GROUP OF STUDENTS

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
$\bar{X}$	1.16	1.15	0.90	2.00	1.52	1.56
N	50	20	29	24	23	25

A "score" for question one is the number of accepted answers given by a student, minus the number of unaccepted answers. The ten accepted answers, some with acceptable variations, are given below:

1. Mating.
2. Nesting or nest building.
3. Making territories, singing territorial songs, displays,etc.
4. Attracting a mate, frogs singing, etc.
5. Egg laying.
6. Birth.
7. Caring for new offspring.
8. Migrating.
9. Returning to activity from hibernation or dormancy.
10. Developing into adults.

FREQUENCY OF OCCURRENCE OF SELECTED COMMONLY OCCURRING ANSWERS TO QUESTION ONE, EXPRESSED AS PERCENT OF STUDENTS WHO GAVE EACH ANSWER

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
Mating	6.0	10.0	3.5	29.2	13.0	12.0
Nesting	18.0	15.0	31.0	33.3	43.5	20.0
Territory	2.0	0.0	0.0	0.0	0.0	0.0
Egg laying	22.0	20.0	20.7	12.5	17.1	20.0
Birth	26.0	20.0	10.3	29.2	21.8	12.0
Mate attr-acting	6.0	30.0	10.3	4.2	0.0	0.0
N	50	20	29	24	23	25

QUESTION TWO

FREQUENCY OF RESPONSE, EXPRESSED IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	2.0	5.0	6.9	4.2	0.0	4.0
2.	0.0	5.0	0.0	0.0	13.0	12.0
3.	40.0	5.0	17.2	33.3	26.1	28.0
4.	2.0	0.0	3.5	0.0	0.0	0.0
5.	0.0	0.0	3.5	4.2	4.4	0.0
6.	50.0	30.0	38.0	50.0	39.1	48.0
7.	4.0	35.0	17.2	8.3	8.7	0.0
8.	2.0	20.0	13.8	0.0	8.7	8.0
N	50	20	29	24	23	25

Response 1 includes those students whose answers considered seasonal change in daylength as the primary clue or mechanism that "tells" animals that spring is coming.

Response 2 includes those who wrote of some biological clock type of internal timing device serving as the mechanism.

Response 3 for question two includes students who wrote that "instinct" was the cause and did not elaborate on their answers.

Response 4 students answered in a manner to indicate that they think animals receive clues to the coming of spring by seeing other animals and/or plants preparing for spring.

Response 5 includes those who gave a combination of response 4 and response 6 answers.

Response 6 includes students who answered that animals receive notice of the approach of spring from weather tactile clues, visual clues, or both.

Response 7 includes all students whose response indicated that they did not understand the question.

Response 8 includes those who did not answer question two.

QUESTION THREE

MEAN SCORE FOR EACH GROUP OF STUDENTS

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
$\bar{X}$	1.92	1.35	1.79	1.79	1.43	1.88
N	50	20	29	24	23	25

Score criteria for question three, tests 4-A and 4-B are identical to those used for question three, test three. The criteria are given on page 299.

QUESTION FOUR

MEAN SCORE FOR EACH GROUP OF STUDENTS

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
$\bar{X}$	0.76	0.45	0.83	0.71	0.87	0.96
N	50	20	29	24	23	25

A "score" for question four is the number of accepted answers given by a student, minus the number of unaccepted answers. Seven accepted answers with acceptable variations are given below. The first five are identical to the accepted answers for question four, test three.

1. Plant buds present.
2. Seed dispersal, or seeds spread or shed.
3. Animals (selected species) have breeding colors.
4. Mating season (select species of animals).
5. Dormant insect eggs and/or pupae.
6. Animals (selected) returned from winter dens or from wintering grounds.
7. Animals (selected) gathering nesting materials.

QUESTION FIVE

The response grouping used to categorize students' responses to question five, tests 4-A and 4-B, is identical to the grouping used for grouping responses to question four, test one. The grouping criteria are given on page 280.

QUESTION FIVE (Continued)

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	20.0	0.0	6.9	29.2	0.0	8.0
2.	0.0	0.0	0.0	0.0	0.0	0.0
3.	4.0	15.0	24.2	37.5	30.5	24.0
4.	38.0	35.0	20.7	20.8	39.1	48.0
5.	10.0	20.0	13.8	8.3	17.4	16.0
6.	4.0	20.0	13.8	0.0	8.7	4.0
7.	0.0	10.0	20.7	4.2	4.3	0.0
N	50	20	29	24	23	25

QUESTION SIX

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	30.0	70.0	31.0	75.0	39.1	48.0
2.	12.0	0.0	6.9	0.0	13.0	4.0
3.	20.0	0.0	13.8	4.2	17.4	8.0
4.	30.0	20.0	38.0	12.5	13.0	32.0
5.	8.0	10.0	10.3	8.3	17.4	8.0
N	50	20	29	24	23	25

QUESTION SIX (Continued)

Response category 1 includes those students who answered in a manner indicating they believed attraction of a mate is the primary reason for toad and other amphibian spring singing. Response 1 is considered to be the best response for question six, tests 4-A and 4-B.

Response category 2 includes those students who wrote that toad and other amphibian singing is the result of "instinct", or that it is "normal behavior" for these animals in the spring.

Response 3 includes those students who wrote that favorable temperatures or weather caused such singing in the animals in the spring.

Response 4 answers include a variety of incorrect answers. The most common answers being, "they are happy" and "they like to sing".

Response 5 includes those students who did not answer question six, and those whose answers indicated that they did not understand the question.

QUESTION SEVEN

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	2.0	5.0	0.0	0.0	0.0	4.0
2.	4.0	5.0	13.8	8.3	4.3	4.0
3.	6.0	0.0	3.4	0.0	8.7	12.0
4.	10.0	10.0	3.4	20.8	21.8	8.0
5.	24.0	50.0	41.4	20.8	61.0	16.0
6.	50.0	20.0	24.2	50.0	4.3	40.0
7.	4.0	10.0	13.8	0.0	0.0	16.0
N	50	20	29	24	23	25

Response category 1 above is considered to be the best response and response 6 is considered to be the least acceptable answer. Response group 7 includes those students who did not answer question seven.

QUESTION SEVEN (Continued)

Response 1 includes those students who wrote that a variety of events would occur when ducks don't find sufficient numbers of good nesting sites in an area. In order that a response be placed in response category 1, two or more of the following ideas were necessary: 1. Some ducks would fail to nest in the area and the duck population for the area would go down; 2. Some ducks would leave to find nesting sites in other areas and this would result in a reduction in the duck population in the area; 3. Nests would be spaced too closely and fewer than normal ducklings would survive, resulting in a population decrease; 4. Ducks (some) would nest in "poor" sites and fewer than normal ducklings would survive, resulting in a reduction in the duck population. Greater than normal loss of ducklings to predators was indicated by one student, as a cause for reduced duckling survival in poor nesting sites.

Response 2 includes students whose answer indicated they thought ducks would nest in poor nesting sites and that the duck population (in general) would be reduced because fewer than normal young would survive.

Response 3 includes those who answered that adult ducks would fail to nest, or that adult ducks would move to other areas and find good nesting sites, and that population reduction would result if no good sites were found.
Response 4 includes those whose responses indicated simply that the "population goes down."

Response 5 includes those students who wrote that "the ducks would die", or some statement indicating they believed the ducks would become extinct.

Response 6 includes a variety of answers which either said, or implied, that the ducks would move to other areas and find adequate nesting sites.

Response 7 includes those who did not answer, those that wrote that they did not know an answer to question seven, and those whose response indicated that they did not understand the question.

QUESTION EIGHT - FIRST PART

The response grouping used to categorize students' answers to question eight, part one, is identical to the grouping used to categorize answers to question eight, part one, test three. This grouping is given on page 303.

QUESTION EIGHT - FIRST PART (Continued)

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	4.0	0.0	3.4	4.2	17.2	12.0
2.	82.0	75.0	79.4	91.7	56.6	68.0
3.	14.0	5.0	6.9	0.0	21.8	8.0
4.	0.0	20.0	10.3	4.2	4.3	12.0
N	50	20	29	24	23	25

QUESTION EIGHT - SECOND PART

MEAN SCORE FOR EACH GROUP OF STUDENTS

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
$\bar{X}$	1.56	1.65	2.10	1.58	2.30	2.48
N	50	20	29	24	23	25

Score criteria for question eight, second part, tests 4A and 4B, are identical to those used for question eight, second part, test three. The criteria are given on page 303.

QUESTION NINE - FIRST PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	70.0	70.0	62.1	95.8	91.4	60.0
2.	28.0	10.0	27.6	4.2	4.3	32.0
3.	2.0	20.0	10.3	0.0	4.3	8.0
N	50	20	29	24	23	25

Response 1 above, considered to be the best answer, includes those who gave the name "dragonfly" for their answer.

Response 2 includes a variety of incorrect answers, and response 3 includes students who did not answer the first part of question nine.

QUESTION NINE - SECOND PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	50.0	50.0	69.0	54.1	74.0	76.0
2.	44.0	40.0	17.2	41.7	4.3	24.0
3.	4.0	0.0	0.0	4.2	8.7	0.0
4.	2.0	10.0	13.8	0.0	13.0	0.0
N	50	20	29	24	23	25

Response 1 answers are considered to be the best answers, and include such responses as: in water, in ponds, in lakes, or in streams.

Response 2 includes students who wrote any terrestrial habitat for their answer, and students who indicated they believed dragonflies grew up "by" or "near" ponds, streams, and the like.

Response 3 includes students whose answers implied that they did not understand the question.

Response 4 includes all students who did not answer the second part of question nine.

QUESTION TEN

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	16.0	0.0	10.3	0.0	4.3	12.0
2.	16.0	20.0	6.9	20.8	21.8	8.0
3.	0.0	0.0	6.9	4.2	17.4	12.0
4.	12.0	5.0	13.8	16.6	0.0	24.0
5.	46.0	50.0	38.0	45.9	34.9	24.0
6.	4.0	5.0	6.9	4.2	13.0	4.0
7.	6.0	20.0	17.2	8.3	8.7	16.0
N	50	20	29	24	23	25

QUESTION FOUR - FIRST PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	41.7	55.0	50.0	63.6	74.0	57.2
2.	8.3	10.0	9.4	0.0	0.0	17.8
3.	4.2	10.0	6.3	0.0	8.7	7.2
4.	0.0	5.0	12.5	13.6	4.3	7.2
5.	45.9	20.0	21.9	22.7	13.0	10.7
N	24	20	32	22	23	28

The response grouping used to categorize students' answers to question four - first part, tests 5-A and 5-B, is identical to the grouping used for question seven - first part, tests one, two, and three. The grouping criteria are given on page 283.

QUESTION FOUR - SECOND PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	12.5	30.0	12.5	22.7	34.9	21.4
2.	0.0	0.0	6.3	0.0	8.7	7.2
3.	87.5	70.0	78.1	77.3	56.6	71.4
4.	0.0	0.0	3.1	0.0	0.0	0.0
N	24	20	32	22	23	28

The response grouping used to categorize students' answers to this question is identical to the grouping used for question seven - second part, tests one, two, and three. The grouping criteria are given on page 284.

QUESTION FIVE

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	8.3	10.0	6.3	0.0	21.8	7.2
2.	0.0	5.0	3.1	0.0	0.0	0.0
3.	33.3	5.0	18.7	27.3	8.7	35.7
4.	0.0	5.0	12.5	4.5	17.4	7.2
5.	12.5	15.0	21.9	9.1	39.1	14.3
6.	45.9	45.0	18.7	54.6	8.7	35.7
7.	0.0	5.0	12.5	4.5	0.0	0.0
8.	0.0	10.0	6.3	0.0	4.3	0.0
N	24	20	32	22	23	28

The response grouping used to categorize students' answers to question five, tests 5-A and 5-B, is identical to the grouping used for responses to question eight, tests one and two. The grouping criteria are given on page 284.

QUESTION SIX - FIRST PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	87.5	90.0	81.2	86.3	100.0	78.6
2.	8.3	0.0	12.5	9.1	0.0	14.3
3.	4.2	10.0	6.3	4.5	0.0	7.2
N	24	20	32	22	23	28

QUESTION SIX - FIRST PART (Continued)

The response grouping used to categorize students' answers to question six - first part, tests 5-A and 5-B, is identical to the grouping used for question nine - first part, tests one and two. The grouping criteria are given on page 285.

QUESTION SIX - SECOND PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	20.8	20.0	21.9	45.4	30.5	35.7
2.	75.0	65.0	68.8	31.8	56.6	57.2
3.	4.2	15.0	9.4	22.7	13.0	7.2
N	24	20	32	22	23	28

The response grouping used to categorize students' answers to question six - second part, tests 5-A and 5-B, is identical to the grouping used for question nine - second part, tests one and two, and question five, test three. The grouping criteria are given on page 286.

QUESTION SEVEN - FIRST PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	37.5	30.0	46.9	45.4	30.5	50.0
2.	0.0	15.0	6.3	4.5	4.3	0.0
3.	12.5	10.0	9.4	4.5	4.3	14.3
4.	50.0	40.0	37.5	40.9	61.0	35.7
5.	0.0	5.0	0.0	4.5	0.0	0.0
N	24	20	32	22	23	28

QUESTION SEVEN - FIRST PART (Continued)

The response grouping used to categorize students' responses to question seven - first part, tests five-A and five-B, is identical to the grouping used for question ten-first part, tests one and two. The grouping criteria are given on page 287.

QUESTION SEVEN - SECOND PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	45.9	45.0	34.4	36.4	26.1	42.9
2.	25.0	25.0	28.1	40.9	30.5	14.3
3.	0.0	5.0	21.9	4.5	17.4	14.3
4.	29.2	20.0	15.6	18.2	26.1	28.6
5.	0.0	5.0	0.0	0.0	0.0	0.0
N	24	20	32	22	23	28

The response grouping used to categorize students' responses to question seven - second part, tests five-A and five-B, is identical to the grouping used for question ten-second part, tests one and two. The grouping criteria are given on page 288.

QUESTION EIGHT

The response grouping used to categorize students' responses to question eight, tests five-A and five-B, is identical to the grouping used for question two, tests four-A and four-B. The grouping criteria are given on page 308.

QUESTION EIGHT (Continued)

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	4.2	10.0	9.4	0.0	8.7	3.6
2.	4.2	10.0	0.0	0.0	8.7	3.6
3.	50.0	15.0	21.8	45.4	34.9	35.7
4.	0.0	0.0	6.3	0.0	4.3	0.0
5.	8.3	5.0	0.0	4.5	0.0	3.6
6.	33.3	40.0	46.9	40.9	34.9	50.0
7.	0.0	5.0	6.3	0.0	4.3	0.0
8.	0.0	15.0	9.4	9.1	4.3	3.6
N	24	20	32	22	23	28

QUESTION NINE

MEAN SCORE FOR EACH GROUP OF STUDENTS

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
$\overline{X}$	1.54	0.70	1.16	1.82	1.65	1.29
N	24	20	32	22	23	28

Score criteria for question nine, tests five-A and five-B, are identical to those used for question one, tests four-A and four-B. The criteria are given on page 307.

QUESTION TEN

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	25.0	0.0	3.1	0.0	4.3	17.8
2.	37.5	10.0	12.5	27.3	21.8	17.8
3.	8.3	0.0	3.1	9.1	4.3	0.0
4.	0.0	10.0	18.7	4.5	4.3	14.3
5.	16.6	30.0	46.9	27.3	21.8	28.6
6.	12.5	10.0	9.4	18.2	21.8	14.3
7.	0.0	40.0	6.3	13.6	21.8	7.2
N	24	20	32	22	23	28

The response grouping used to categorize students' responses to question ten, tests five-A and five-B, is identical to the grouping used for question ten, tests four-A and four-B. The grouping criteria are given on page 315.

QUESTION ELEVEN

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	33.3	35.0	50.0	81.8	56.6	53.6
2.	4.2	0.0	6.3	0.0	13.0	0.0
3.	0.0	5.0	9.4	4.5	13.0	7.2
4.	45.9	45.0	28.1	4.5	8.7	35.7
5.	16.6	15.0	6.3	9.1	8.7	3.6
N	24	20	32	22	23	28

QUESTION ELEVEN (Continued)

The response grouping used to categorize students' responses to question eleven, tests five-A and five-B, is identical to the grouping used for question six, tests four-A and four-B. The grouping criteria are given on page 311.

QUESTION TWELVE

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	0.0	0.0	3.1	0.0	4.3	7.2
2.	8.3	0.0	0.0	4.5	0.0	3.6
3.	41.7	15.0	43.8	50.0	30.5	32.1
4.	0.0	0.0	0.0	0.0	4.3	0.0
5.	33.3	30.0	9.4	9.1	17.4	28.6
6.	12.5	25.0	37.5	22.7	34.9	21.4
7.	4.2	30.0	6.3	13.6	8.7	7.2
N	24	20	32	22	23	28

The response grouping used to categorize students' responses to question twelve, tests five-A and five-B, is identical to the grouping used for question twelve, tests one and two. The grouping criteria are given on page 288.

SCHOOL STAFF QUESTIONNAIRE ENVIRONMENTAL EDUCATION PROGRAM

1. If each of the ten environmental education audio-taped lessons were housed separately in labeled boxes, do you think you could set them up for student use? (yes, no, comments -- USE ANSWER SHEET FOR ALL ANSWERS)

2. Do you think the process of setting up the lessons would take too much of your time to be worthwhile? (yes, no, comments)

3. Do you think mechanical problems with the lesson hardware (tape recorder, slide viewer, ear phones) would result in too much time and trouble to be worth managing the lessons? (yes, no, comments)

4. If you were to continue these lessons in your school next year, where would you prefer to have them placed -- that is, where do you think the lesson booths would best be placed in your school? (coreroom classroom, science classroom, learning-center, social science classroom, other)

5. If you were in charge of figuring out how to schedule students in order to get them through the audio-taped lessons during the season of the year for which they are intended, would you find this task; to be impossible, very difficult, difficult, a minor problem, no problem, other?

6. Briefly describe what factors you feel are most responsible for regulating the number of students who can go through the lessons in a given period of time -- such as a day or a week.

7. Do you think the students have enjoyed the environmental education lessons? (yes, no, comments)

8. If you think the students are learning from the environmental education audio-taped lessons, please briefly cite some reasons for your belief.

9. Do you think the students' listening skills have improved BECAUSE OF the listening requirements of the audio-taped lesson presentation? (yes, no, comments)

10. Have you heard the students talking about the lessons, or using words or ideas from the audio-taped lessons in conversations with each other? (yes, no, comments)

11. Have the students talked about the lessons or used words and/or ideas from the lessons in conversations with you? (yes, no, comments)

12. Have parents mentioned something about the environmental education program or lessons during parent-teacher conferences or in other conversations with you? (yes, no, comments)

13. Have you listened through any of the audio-taped lessons? (yes, no, comments)

14. How many of the audio-taped lessons did you finish? (number)

15. Answer the following only if you have listened in whole or in part to one or more of the audio-taped lessons. Do you feel you learned anything from the environmental education lessons you attended? (yes, no, comments)

16. If you were able to answer the last question, please answer the following question. Did you learn anything in the lessons that you feel is important to the education of upper elementary school children? (yes, no, comments)

17. Classroom teachers and science teachers only. Did you and your classes carry on any activities IN YOUR CLASSROOM that resulted from learnings by either you or by your students from attendance at the audio-taped lessons? (yes, no, comments)

18. Classroom teachers and science teachers only. Did you and your classes conduct any activities in your classroom that you feel resulted from learnings that occured during post lesson field trips? (yes, no, comments)

19. Do you feel that upper elementary school instruction should include the information found in the audio-taped environmental education lessons? (yes, no, comments)

20. If your answer to the last question was affirmative, do you think this instruction should take place in any particular discipline area or areas of the upper elementary school curricula, or do you think such instruction should be a part of all disciplines? (list either, "no answer", or "all disciplines", or list the specific disciplines that you feel should include environmental education instruction such as that found in the audio-taped lessons)

21. Do you feel that the students benefited from playing the group winter wildlife ecology game, "How Was Your Winter?", and if so, in what manner do you feel they benefited? (yes, no, comments)

22. If you think the winter wildlife ecology game has value to upper elementary school students, tell where in the school you think the game would best be used. (name of room or rooms)

23. Have you attended any of the outdoor field trips that are a part of this environmental education program? (yes, no, comments)

24. Do you feel capable of conducting outdoor environmental education field trips yourself? (yes, no, comments)

25. Would you be willing to conduct outdoor environmental education field trips for upper elementary school students? (yes, no, comments)

RESPONSES TO SCHOOL STAFF QUESTIONNAIRE

QUESTION ONE

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Yes	6	2	2	10
No	0	0	0	0
Comments	0	0	0	0

QUESTION TWO

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Yes	1*	0	0	1
No	5	2	2	9

Comments * "(There is) to much (to do) to get 6th graders ready for junior high, but (setting up lessons) would not take too much time for the 5th graders."

QUESTION THREE

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Yes	1*	0	0	1
No	5	2	2	9

Comments * "Earphone plugs had to be soldered, bulb burned out. I would not know how to fix any of it and could drop hours trying."

QUESTION FOUR

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Classroom	5*	2	0	7
Learning Center	1	0	2	3
Other	0	0	0	0

Comments * "(In the classroom) supplemental enrichment can be coordinated with English, spelling, math, etc."

QUESTION FIVE

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
No Problem	2	0	2	4
Small Problem	4	2	0	6
Other Answers or Comments	0	0	0	0

QUESTION SIX

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
School Periods (time) (Departmentalized)	4	1	1	6
School Program (Group Activities)	3*	1	1	5
Other Classroom Group Activities	3	0	1	4
Classroom Teacher Remembering Lessons	2	0	0	2
Location of Lesson Booths	1	1	0	2
Length of Lessons (Time duration)	1	0	1	2
Number of Lesson Copies Available for use	1	0	0	1
Problems with Lesson Equipment	1	0	0	1
Student lack of Mechanical Ability	0	0	1	1
Number of Students in the class	0	0	1	1

Other Comments * "Assembly programs, group testing, group trips, music lessons, and other school programs interfere with (lesson) usage."

QUESTION SEVEN

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Yes	6*	2	2**	10
No	0	0	0	0

Comments * "most of them (have enjoyed the lessons)."

* "very much so."

* "They have liked them as an interesting variation in the learning routine."

** "(They have enjoyed) especially the game (winter wildlife ecology game)."

QUESTION EIGHT

Classroom Teachers' responses

"They have picked up information that they have transmitted to me -- in the class and when outside."

"Post (audio-taped) lesson conversations, and (they are) eager to do them."

"Discussions in homeroom -- bird club. (They are) eager to do each lesson -- can't wait for their turn."

"I have little opportunity to discover what they have learned unless I ask them point blank. Perhaps this would show up more in the science area."

"I'm sure they are learning some things; I have noticed however that they do not voluntarily discuss them with each other (in the classroom)."

"Criticism of my wearing a fur coat. I presented to a sixth grader the necessity of mother nature keeping animal populations numbers within bounds (by) predators, starvation, disease, mass-suicide -- lemmings -- and natural enemies."

Science Teachers' responses

"Comments on field trips and statements -- 'I know that from the (audio-taped) lessons.'"

"Many children seem to be more aware of their outdoor surroundings."

Learning Center Teachers' responses

"Interest level seems high -- students (are) willing to co-operate."

"(The students') enthusiasm -- and understanding in the use of the game (winter wildlife ecology game)."

QUESTION NINE

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Yes	0	0	2	2
No	2	0	0	2
Not sure or Don't Know	4	0	0	4
Not Measurable	0	1	0	1
Not Measurable because of the use of much audio and visual learning media	0	1	0	1

QUESTION TEN

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Yes	3	2	1	6
No	3	0	1	4
Comments	0	0	0	0

QUESTION ELEVEN

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Yes	6*	2	1	9
No	0	0	1	1

Comments * "Have discussed field trips."
"(Their) vocabulary (has been) enriched with ecology terms."
"yes -- when teacher initiated."

QUESTION TWELVE

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Yes	0	0	0	0
No	6	2	1	9
No Answer	0	0	1	1

QUESTION THIRTEEN

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Yes	5*	2	1	8
No	1**	0	1	2

Comments * "very enjoyable and informative."
** "part way -- I never finished any."

QUESTION FOURTEEN

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number of Teachers
Average Number of lessons finished (Mean)	2.2	7.5	2.0	8

QUESTION FIFTEEN

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Yes	5	2*	1	8
No	1	0	0	1

Comments * "the lessons were extremely well done -- a valuable learning tool."

QUESTION SIXTEEN

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Yes	5	2	1	8
No	1*	0	0	1

Comments * "but I feel the lessons would be important for the age group specified."

QUESTION SEVENTEEN

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Yes	2	2	X	4
No	4	0	X	4

The two Learning Center Teachers were excluded from question seventeen.

QUESTION SEVENTEEN (Continued)

Classroom Teachers' Comments

"We have no science activities -- they (the students) have a science class teacher."

Science Teachers' Comments

"We had discussion and individual (student) research. (We also) built bird houses in the shop with the aid of the art and shop teacher."

"Food chains -- plant changes -- plant adaptations."

QUESTION EIGHTEEN

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Yes	5	1**	X	6
No	1*	1	X	2

Comments * "None, other than a review of what they knew when we were out walking."

** "(We or they) classified seeds by size and type."

The two Learning Center Teachers were excluded from question eighteen.

QUESTION NINETEEN

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Yes	5*	2	2	9
No	0	0	0	0
No Answer	1	0	0	1

Comments * "The curriculum should be up-graded, especially making children more aware of their environment."

QUESTION TWENTY

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
All Disciplines	4	1	1	6
Science & Social Science	0	0	1	1
Science, Social Sc., and English	1*	0	0	1
Geography, Language Arts, and Art	0	1	0	1
No Answer	1	0	0	1

Comments * "(Environmental education instruction should take place in) English, as supplemental for subject matter and the authoring of research papers; in Social Studies, only as it relates to our area."

QUESTION TWENTY-ONE

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Yes	5*	2**	1***	8
No	1	0	0	1
No Answer	0	0	1	1

Comments * "Only a few -- about four -- got to play it in (my) sixth grade group."

* "They enjoyed it and they learned some things from it."

* "They enjoyed the game tremendously -- and it seemed to 'cement' information."

* "They learned about wildlife habitats in a fun way."

** "An awareness of the requirements of different animals in winter was developed by a number of children."

** "(They) became aware of relationships of animals to micro-environments."

*** "Enthusiasm and understanding -- it was a favorite choice (of activity in the learning center)."

QUESTION TWENTY-TWO

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Learning Center	2*	1	1	4
Classroom and Learning Center	0	1	0	1
Classroom, Learning Center & Science Rm.	3	0	0	3
No Answer	1**	0	1**	2

Comments * "It (the game) should be available for checking out to individual classrooms, too."

* "(The game should be in the Learning Center) with an aide to help in getting the kids started playing it."

** Neither of these two teachers were involved with the program during the winter months and they wrote that they were "unfamiliar with the game."

QUESTION TWENTY-THREE

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Yes	0	2	0	2
No	6	0	2	8
Comments	0	0	0	0

QUESTION TWENTY-FOUR

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Yes	4*	1	1	6
No	2	0	1	3
Yes and No	0	1**	0	1

Comments * "With help before hand."

** "Yes, with small groups -- but not with large groups."

QUESTION TWENTY-FIVE

Response	Classroom Teachers	Science Teachers	Learning Center Teachers	Total Number
Yes	6*	1	1**	8
No	0	0	1***	1
Yes and No	0	1****	0	1

Comments

* "If (I were) instructed before hand."

* "In small groups."

* "But not with large classes."

* "Definitely!"

* "If: the lesson objectives and objects to be studied are carefully identified previously, the groups are not larger than five, and the teacher has absolute authority and is not compeled to take any trouble-makers who can prevent all learning."

** "Yes, with training!"

*** "Difficult (to consider) under present time allotments."

**** "Yes, (I would be willing to conduct outdoor environmental education field trips) as an individual classroom teacher, but not as a specialist."

QUESTION TEN (Continued)

Response 1 category above includes students whose answers indicated that they thought spring offers the best food supply for does and fawns.

Response 2 includes those who wrote that birth in the spring offers the maximum growth period for fawns before winter.

Response 3 includes those whose answers indicated they believed spring birth offers the best chances for survival, but gave no explanation as to a reason for optimum survival chances.

Response 4 includes students who wrote that the reasons for spring birth in deer are either "instinct" or "nature's way", or they gave some other answer that indicated they believed spring is the "natural" time for the birth of fawns.

Response 5 includes students whose answers indicated that they compared spring weather with either winter weather, a season which they indicated would be too cold for the birth of fawns, or to summer weather, a time which they felt would be too hot for the birth of fawns.

Response 6 includes students who gave a variety of answers, all of which were less adequate than answers in the above categories in explaining the advantages of springtime birth of fawns. The most commonly occurring answer was that "spring offers the best hiding places".

Response 7 includes all students who did not answer question ten.

QUESTION ELEVEN

FREQUENCY OF RESPONSE, EXPRESSED IN
PERCENT OF STUDENTS FROM EACH OF THE GROUPS

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	0.0	70.0	44.9	16.6	69.6	32.0
2.	76.0	20.0	41.4	58.3	21.8	48.0
3.	22.0	10.0	10.3	25.0	0.0	12.0
4.	2.0	0.0	3.4	0.0	8.6	8.0
N	50	20	29	24	23	25

QUESTION ELEVEN (Continued)

The response grouping used to categorize students' answers to question eleven, tests 4A and 4B, is identical to the grouping used to categorize responses to question eleven, test three. The grouping criteria are given on page 305.

QUESTION TWELVE - FIRST PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	34.0	20.0	38.0	41.7	17.4	36.0
2.	16.0	30.0	10.3	25.0	39.1	12.0
3.	34.0	15.0	17.2	20.8	8.7	12.0
4.	12.0	20.0	17.2	8.3	21.8	36.0
5.	4.0	15.0	17.2	4.2	13.0	4.0
N	50	20	29	24	23	25

Response 1, considered to be the best response, includes students who used "flowers", or "opening flower buds" as their answer to the first part of question twelve.

Response category 2 includes those students who listed either "buds" or "leaf buds" for their answer.

Response 3 includes those who wrote that leaves was the correct answer.

Response 4 includes students who listed any plant part not found in categories above.

Response category 5 includes students who did not answer the first part of question twelve, and students whose answers indicated that they did not understand the question.

QUESTION TWELVE - SECOND PART

The table of response frequencies for the second part of question twelve is on the next page. Response category 1 is considered to be the best response.

QUESTION TWELVE - SECOND PART (Continued)

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	72.0	60.0	65.5	66.7	56.6	52.0
2.	2.0	0.0	3.4	0.0	0.0	0.0
3.	2.0	10.0	0.0	8.3	4.3	8.0
4.	18.0	25.0	6.9	25.0	13.0	32.0
5.	6.0	5.0	24.2	0.0	26.1	8.0
N	50	20	29	24	23	25

Response category 1 includes those students who indicated that either "food" or "food energy" is the most important material necessary to the health and survival of new spring wildlife babies.

Response 2 includes those who wrote that "space" is the most important life requirement material.

Response 3 includes all students who used "warmth" as their answer.

Response 4 includes a variety of answers. The most commonly occurring answers in this category were, "protection", "mother's care", and "water".

Response category 5 includes students that did not answer the second part of question twelve and students whose answers indicated that they did not understand the question.

STUDENT RESPONSES TO TESTS 5-A AND 5-B QUESTIONS

QUESTION ONE - FIRST PART

MEAN SCORE FOR EACH GROUP OF STUDENTS

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
$\overline{X}$	2.71	2.35	2.16	3.14	3.22	2.43
N	24	20	32	22	23	28

Score criteria for question one are identical to those used for questions one, test one and test two. The criteria are given on page 278.

QUESTION ONE - SECOND PART

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
YES	100.0	90.0	81.2	100.0	100.0	96.5
NO	0.0	10.0	6.3	0.0	0.0	0.0
NO ANSWER	0.0	0.0	12.5	0.0	0.0	3.5
N	24	20	32	22	23	28

QUESTION TWO

The response grouping used to categorize students' responses to question two, tests 5-A and 5-B, is identical to the grouping used for responses to question four, test one, question four, test two, and question five, tests 4-A and 4-B. The grouping criteria are given on page 280.

QUESTION TWO (Continued)

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	8.3	10.0	6.3	31.8	0.0	17.9
2.	0.0	0.0	0.0	0.0	0.0	0.0
3.	12.5	5.0	15.6	4.5	13.0	14.3
4.	45.9	30.0	15.6	27.3	65.3	42.9
5.	29.2	20.0	21.9	18.2	4.3	3.6
6.	0.0	5.0	34.4	18.2	13.0	21.4
7.	4.2	30.0	6.3	0.0	4.3	0.0
N	24	20	32	22	23	28

QUESTION THREE

The response grouping used to categorize students's responses to question three, tests 5-A and 5-B, is identical to the grouping used to categorize responses to question five, test one and question five, test two. The grouping criteria are given on page 281.

FREQUENCY OF RESPONSE, EXPRESSED
IN PERCENT OF STUDENTS FROM EACH GROUP

	5th Grade Students			6th Grade Students		
	Northeast School	Danby School	Enfield School	Northeast School	Danby School	Enfield School
1.	4.2	0.0	3.1	0.0	8.7	3.6
2.	16.6	20.0	9.4	27.3	34.9	25.0
3.	41.7	35.0	25.0	50.0	39.1	32.1
4.	0.0	5.0	25.0	4.5	0.0	14.3
5.	37.5	40.0	37.5	18.2	17.4	25.0
N	24	20	32	22	23	28